(भारत सरकार)
GOVERNMENT OF INDIA
रेल मंत्रालय (रेलवे बोर्ड)
Ministry of Railways (Railway Board)

IRCAMTECH/GWL/MECH/LHB/1.0
April 2013

MAINTENANCE MANUAL
for
LHB COACHES

अअमा संRDS
रेल अग्रदूत Transforming Railways

An ISO 9001-2008 Certified Organization
उत्कृष्ट अनुरक्षण प्रौद्योगिकी केन्द्र
EXCELLENCE IN MAINTENANCE

Indian Railways
Centre for Advanced Maintenance Technology

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MAINTENANCE MANUAL FOR LHB COACHES

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सदस्य यांत्रिक, रेलवे बोर्ड
एवं
पदेन सचिव, भारत सरकार
रेल मंत्रालय
नई दिल्ली–110001

MEMBER MECHANICAL, RAILWAY BOARD
&
EX-OFFICIO SECRETARY,
GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
NEW DELHI-110001

FOREWORD

Indian Railways entered into a Transfer of Technology agreement with M/s. Alstom Germany for LHB type of Coaches in the year 1995. Accordingly, their introduction and mass production in Railways started in 2002 and their population is growing day by day. These coaches are quite different from ICF design coaches. The maintenance practices for these coaches are also different. Therefore, it has become imperative to prepare a separate maintenance manual specially for these coaches. This manual is an attempt to update information on the current fleet of coaching stock and to upgrade the maintenance practices. "CAMTECH" deserves all praise for bringing out such a well documented and comprehensive guide for the use of our engineers.

The need for proper maintenance of coaches for providing safety and comfort to the traveling public cannot be over-emphasised. It is necessary that correct practices are followed during POH and other maintenance schedules so that coaches give trouble-free and comfortable service on line.

Those of us involved in maintenance must appreciate the importance of right maintenance at right time so that a coach does not come up for unscheduled repairs frequently. The effort should be to minimize overall maintenance time and reduce maintenance costs.

Future addition/deletion/modification to this Manual shall be processed by RDSO/LKO with the approval of Railway Board.

(Keshav Chandra)
Member Mechanical
Railway Board

PREFACE

1. ICF design coaches have been the main passenger carriers of Indian Railways since their inception. It was not possible to attain higher speeds due to inherent design limitations of these coaches. To overcome this problem, Indian Railways entered into a TOT agreement with M/s. Alstom Germany for LHB type of Coaches. Accordingly, their inception and mass production in Railways started in 2002 and population is growing day by day. These coaches are quite different from ICF design coaches. The maintenance practices for these coaches are also different. Therefore, it has become imperative to prepare a separate maintenance manual specially for these coaches.

2. Railway Board had nominated a committee of officers comprising of Executive Director/CAMTECH, CRSE/Northern Railway, CRSE/Western Railway, EDS(Carriage)/RDSO/Lucknow, CWM/Jagadhari/Northern Railway & Dy. CME/RCF/Kapurthala, for preparation of "Maintenance Manual for LHB Coaches."

3. The Committee had examined the maintenance manual supplied by M/s. ALSTOM under TOT, recommendations of various committees formed earlier by the Railway Board, two man committee of W. Rly., instructions issued by RDSO, RCF and the Railway Board from time to time on this subject and various suggestions received from Zonal Railways.

4. The draft manual was submitted to Railway Board vide letter No. IRCAMTECH"/GWL/M/LHB dated 10.05.2010 for approval. The draft manual was examined by Board and further vide Board"s letter No. 2007/M(C)/137/16 VOL-II dated 30.04.2012, Board has decided to review the final draft submitted by committee for some short comings like, latest maintenance instructions issued by RDSO, instructions to zonal railways & PUs by RDSO, details of Air Springs, Phonic wheel maintenance, coupling/uncoupling procedure for CBC, maintenance Proforma for WSP and CTBU maintenance etc. The same has been incorporated in the manual after receiving comments from RDSO, RCF & Zonal railways.

5. The salient features of the manual are as under:-

   i) Latest instructions from Railway Board/CAIs issued by RCF have been included.

   ii) The manual has been divided into assembly-wise chapters. Separate chapters have been provided for electrical and mechanical schedules.

   iii) Important dimensions, clearances, material specifications and references to RDSO technical instructions are given in this manual.

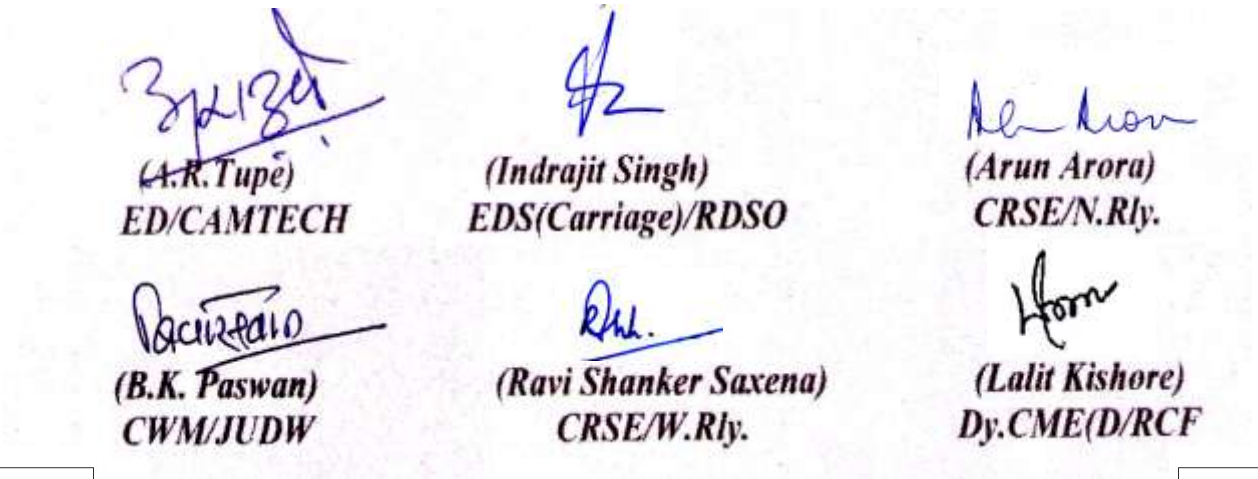
   iv) For convenience of reference, the paragraphs have been numbered according to the number of chapter.

   v) The figures/tables in each chapter consist of two numbers separated by a decimal point. Number before decimal point indicate the chapter number whereas the number after the decimal point is the running serial number of the table/figure which start from 1 in every chapter.

6. Future Addition/deletion/modification to this manual will be issued through correction slips or reprint of chapter by CAMTECH in consultation with RDSO and approval of the Railway Board.

7. The above maintenance manual has been prepared not only with the efforts from the committee members but also from a number of Railway Officers and staff. The committee gratefully acknowledges the support received in its task from the following:-

1. Shri Pramod Kumar, Ex ED/CAMTECH
2. Shri Rajiv Mishra Ex. CRSE/W.Rly
3. Shri S.C.Singhal. Ex ED/CAMTECH
4. Shri A.K.Singh, Ex EDME/Chg. Railway Board
5. Shri Shailendra Singh EDME/(Chg.)/Railway Board
6. Shri D.K.Agrawal Ex ED/Carriage/RDSO/LKO
7. Shri H. K. Kala, Ex CWE/Northern Railway
8. Shri R.S. Kochak, Ex CDE/RCF/KXH
9. Shri A.K.Jain, Ex CWM/JUDW
10. Shri Surbhit Mathur CWM/PL
11. Shri Pradeep Kumar, Ex Dy. CME/PL
12. Shri Arvind Nautiyal, Ex DME/Chg./Railway Board
13. Shri Prashant Kumar, DME/Chg./Railway Board
14. Shri Vivek Bajpai, Ex Sr. CDO/BCT
15. Shri K. Bhatia, Ex Director (Mech)/CAMTECH
16. Shri K.P.Yadav, Director (Mech.)/CAMTECH
17. Shri Vinay Shrivastava , Director (Carriage)/RDSO
18. Shri Rajesh Awasthi , Director (Carriage)/RDSO
19. Shri Shivendra Singh , Director (Carriage)/RDSO
20. Shri Jaideep Gupta, Ex Director (Elect)/CAMTECH
21. Shri Peeyoosh Gupta, Director, Elect.)/CAMTECH
22. Shri Vijay Arora, Ex Sr.DME/NDLS
23. Shri Praveen , ADE (Carriage)/RDSO
24. Shri Rakesh Kumar , ADE Carriage)/RDSO
25. Shri C. B. Arora, SSE/PL
26. Shri Jugal Kishore, SSE/NDLS
27. Shri J. K. Chopra, Ex CTA (Mech.)/CAMTECH
28. Shri Dharmendra Agarwal, CTA (Mech.)/ CAMTECH
29. Shri S. K. Saxena, CTA (Elect)/CAMTECH
30. Shri Sandeep Shrivastava, DEO, CAMTECH



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PREFACE

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2. Railway Board had nominated a committee of officers comprising of ED/PS & EMU/RDSO/Lucknow, CESE/Northern Railway, CESE/Western Railway, Dy.CEE/Jagadhari workshop, CEDE/RCF/Kapurthala and Director/Elect./ CAMTECH for preparation of Maintenance Manual for electrical equipment of LHB Coaches.

3. The Committee has examined the maintenance instructions issued by RDSO, RCF and the Railway Board from time to time on this subject and various suggestions received from Zonal Railways.

4. The salient features of the manual are as under:-
   - vi) Latest instructions from RDSO/modifications issued by RCF have been included.
   - vii) Chapters 6, 7, 8 and 11 have been provided for electrical equipment.
   - viii) Important dimensions, material specifications and references to RDSO technical instructions are given in this manual.
   - ix) For convenience of reference, the paragraphs have been numbered according to the number of chapter.
   - x) The figures/tables in each chapter consist of two numbers separated by a decimal point. Number before decimal point indicates the chapter number whereas the number after the decimal point is the running serial number of the table/figure.

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   - i) Shri S C Singhal, Ex ED/CAMTECH
   - ii) Shri A.R. Tupe, ED/CAMTECH
   - iii) Shri Jaideep Gupta, Ex Director/CAMTECH
   - iv) Shri Prafulla Chandra, Ex DSE/TL & AC System Design, RDSO
   - v) Shri Rizwan Ahmad Jamali/DSE/TL & AC System Design, RDSO
   - vi) Shri Shiv Raj Gautam, SSE/ TL & AC/ RDSO

vii) Shri Pramod Kumar, Ex CEDE/RCF/KXH
viii) Shri Sukhbir Singh, SEE/ Design/RCF/KXH
ix) Shri Mahendra Kumar, Sr.DEE/ Coaching/ NDLS
x) Shri Vivek Dixit, Sr.DEE/ Chg/ BCT/ WRly
xi) Shri Harbir Singh, SSE/ Coaching/ NDLS
xii) Shri Shashi Bhushan Pant, SSE / Coaching/ NDLS
xiii) Shri Paramjeet Singh, SE/ Coaching/ NDLS
xiv) Shri Sunil Kumar Gupta, SEE/ C&C/ HQ, WRly
xv) Shri Anand Kuvalekar, SSE/ Power car/ BCT/ WRly
xvi) Shri P.K.Mishra, CTA/ BCT/ WRly.
xvii) Shri Rakesh Kumar Verma/ CTA/ CCG/ WRly
xviii) Shri ketan suresh more, CTA/ CCG/ WRly
xix) Shri R. D. Bhargav, Sr CTA/ EL/CAMTECH
xx) Shri B. C. Agrawal, Sr CTA/ EL/ CAMTECH
xxi) Shri Shailendra Saxena, CTA/ EL/ CAMTECH
xxii) Smt. Sangeeta Shrivastava, DEO, CAMTECH

ED/ PS & EMU/ RDSO	***CESE/ N.Rly***	***CESE/W.Rly.***
Dy.CEE/ JUDW	***CEDE/RCF/ KXH***	***Director/ Elect./ CAMTECH***

ABBREVIATIONS

&	And
Φ	Diameter
+ve	Positive
^{0}	Degree
^{0}C	Degree Centigrade
A/F	Across face
AC	Air Conditioned
alt.	Alteration
AR	Auxiliary Reservoir
BC	Brake Cylinder
BP	Brake Power
BPC	Brake Power Certificate
BPCL	Bharat Petroleum Corporation
C&W	Carriage & Wagon
CAIs	Coach Alteration Instructions
CBC	Centre Buffer Coupler
CCR	Carriage Controller
CDTS	Control Discharge Toilet System
CEE	Chief Electrical Engineer
cm	Centimetre
CME	Chief Mechanical Engineer
CMI	Carriage Maintenance Instructions
CO_2	Carbon dioxide gas
COM	Chief Operating Manager
CP	Centre Pivot
CR	Control Reservoir
CSC	Chief Security Commissioner
CSK	Counter Sunk
DA	Direct Admission Valve
DC	Direct Current
DEE	Divisional Electrical Engineer
dia. (Dia)	Diameter
DME	Divisional Mechanical Engineer
Drg	Drawing
DRS	Deficiency in Rolling Stock
DV	Distributor Valve
EFT	Emergency Feed Terminal
Elect.	Electrical
EOT Crane	Electric Overhead Travelling Crane
Eq.	Equalising
Fig	Figure
FP	Feed Pipe
FRP	Fibre Reinforced Plastic
GRP	Government Railway Police
Hd.	Head
hex.	Hexagonal
HPC	Hindustan Petroleum Corporation
HRC	Hardness on Rockwell 'C' scale

I.C.	Isolating Cock
ICF	Integral Coach Factory
IOC	Indian Oil Corporation
IOH	Intermediate Overhaul
IRCA	Indian Railway conference Association
IS	Indian Standards
kg	Kilogram
kmph	Kilometre per hour
kW	Kilo Watt
LHB	Linke Holfmann Busch
m	Metre
M.R.	Main Reservoir
Max.	maximum
MCB	Miniature Circuit Breaker
Min.	minimum
mm	Millimetre
no.	Number
nos.	Numbers
OBHS	On Board House Keeping Services.
O.D.	Outer diameter
OCV	Other Coaching Vehicle
PCV	Passenger Coaching Vehicle
PM	Primary Maintenance
POH	Periodic Overhauling
Pr.	Pressure
PVC	Poly Vinyl Chloride
RCF	Rail Coach Factory
RDSO	Research Design and Standard Organisation
ref.	Reference
rev.	Revision
RMPU	Roof Mounted AC Package
RPF	Railway Protection Force
RTR	Rake Testing Rig
SC	Security Commissioner
SG	Self generating
SM	Secondary Maintenance
SMI	Standard Maintenance Instruction
Sp.	Specific
Spec	Specification
Sr. DME	Senior Divisional Mechanical Engineer
SS	Stainless steel
STR	Schedule of Technical Requirements
SWG	Standard Wire gauge
t	Tonne
TL	Train Lighting
V	Voltage
-ve	Negative
WRA	Water Raising System
WSP	Wheel Sliding Protection

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CHAPTER 1

INTRODUCTION

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CHAPTER 1

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INTRODUCTION

1.0 INTRODUCTION

Till recently, Indian Railways have been transporting passenger traffic mainly through coaches of ICF design. These coaches are being manufactured at ICF and RCF. A limited number of these coaches are being manufactured at BEML/Bangalore also. These type of coaches are having limitations in terms of-

i) Speed potential;

ii) Heavy corrosion;

iii) Poor riding comfort;

iv) Wearing of parts in the under gear;

To overcome these limitations, Indian Railways entered into supply and technology transfer contracts with M/s. ALSTOM LHB/Germany to initially supply 24 coaches consisting of 19. AC chair cars, 2 AC Executive Class Chair cars and 3 Generator cum Brake vans. The bogies for these coaches are manufactured by M/s. FIAT/SIG Switzerland. These coaches arrived in India and got commissioned in the year 2001 and put in service . These type of coaches are far superior w.r.t. passenger comfort, safety, speed, corrosion, maintenance and aesthetics. These coaches are also longer as compared to ICF design resulting into more carrying capacity. The expected benefits from these type of coaches are as under:-

i Higher carrying capacity - These coaches are about 2 meters longer than ICF coaches. With this extra length two additional rows of chairs in chair cars or one additional bay in sleeper coaches can be accommodated.

ii The weight of LHB coach is lesser as compared to ICF design coaches. LHB coach can accommodate 72 passengers as compared to 64 in conventional AC III Tier Coach. Thus giving better pay to tare ratio.

iii Low corrosion – There will be low corrosion of LHB coaches due to extensive usage of Stainless Steel and better design and manufacturing techniques.

iv Low Maintenance – Replacement and removal of sub-systems will be required only after one million kilometers.

v LHB Coaches have aesthetically superior interiors with FRP panels for side wall and roof. They can be removed easily for maintenance, resist water seepage and are wear resistant;

vi There are no visible screws inside the passenger compartment.

vii Better passenger comfort: Better Riding Index has been specified as compared to conventional ICF coaches.

viii LHB coach offers better passenger safety due to:

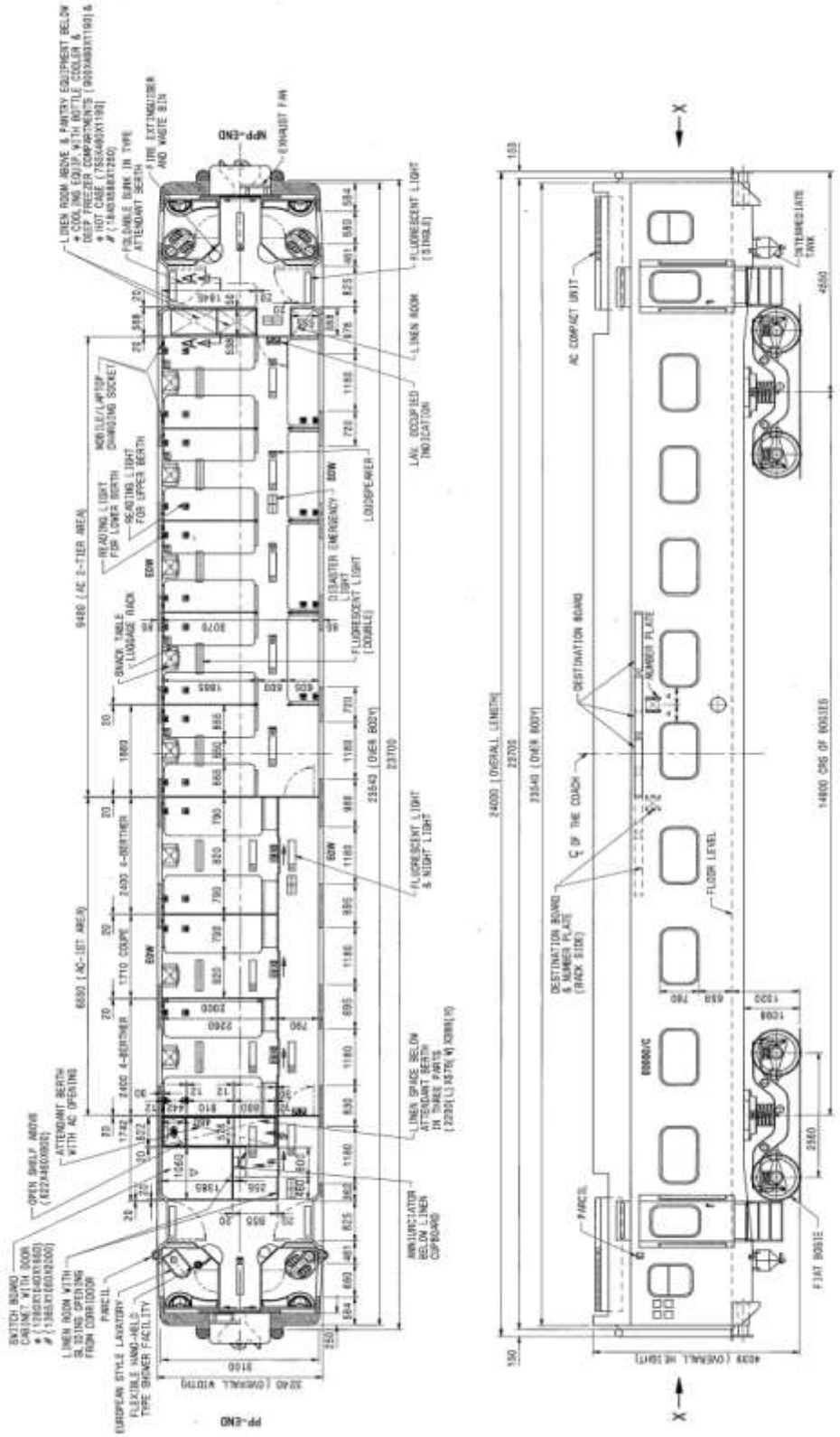
- Use of fire retardant materials for furnishing.
- Provision of emergency open able windows.
- Vertically interlocked Centre Buffer Couplers.

xi LHB coach offers better passenger amenities due to :

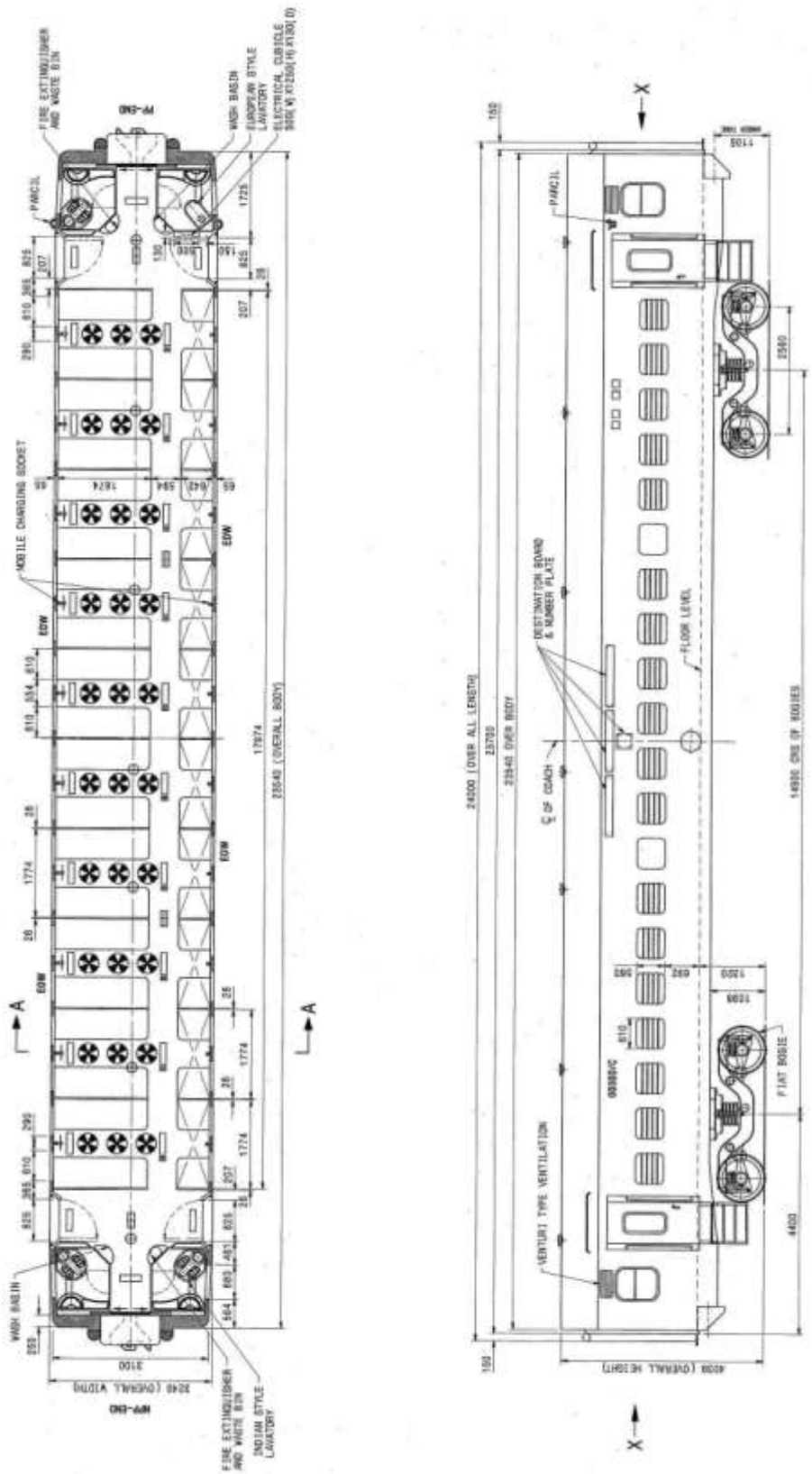
- More space for pantry;
- Individual reading light in chair car;
- Ergonomically designed chairs with reclining back rest

1.1 IMPORTANT PARAMETERS OF LHB COACHES

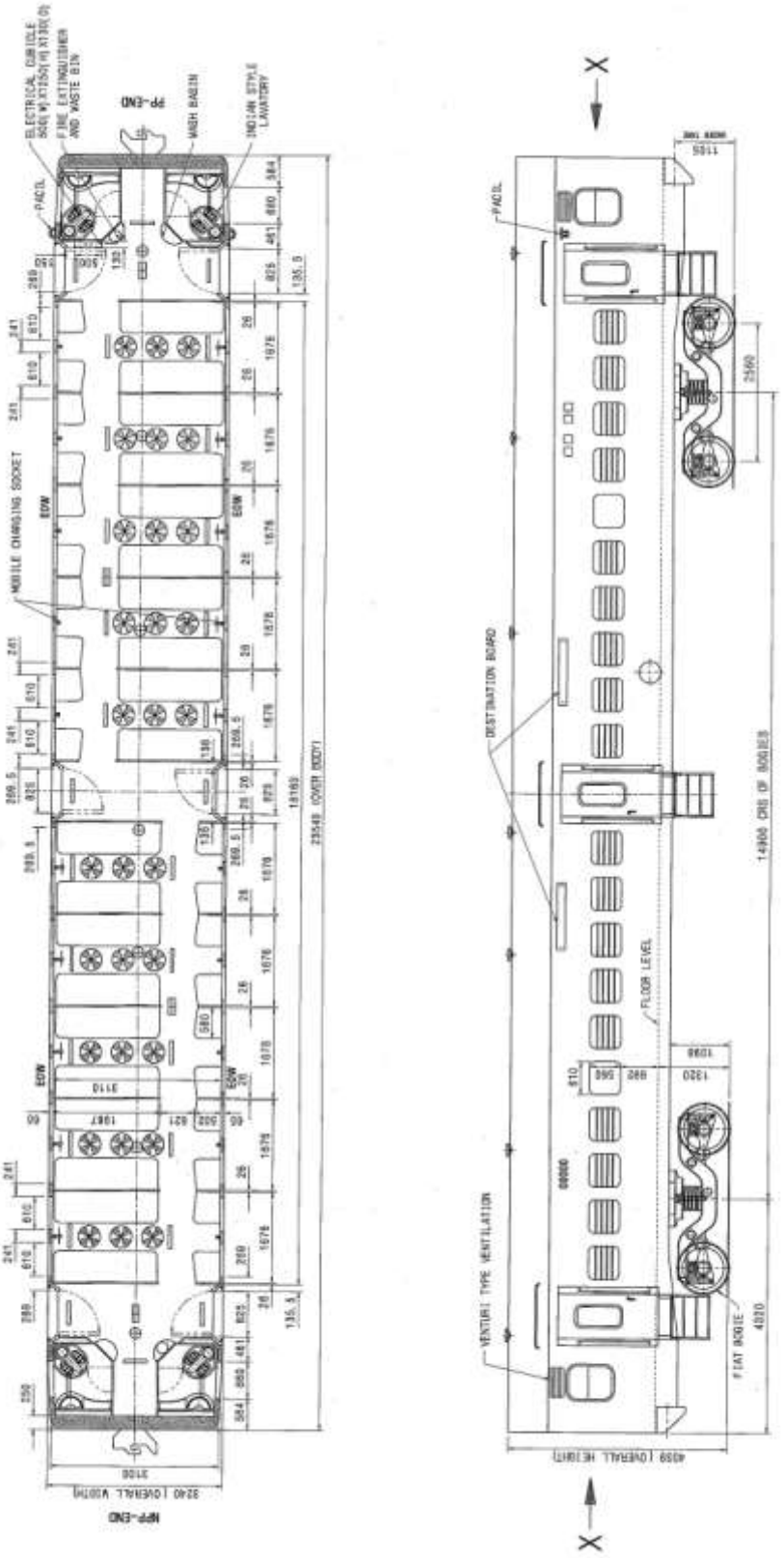
Sr. no	TYPE OF COACH	CODE	DRAWING NO.	No. of seat /berth	Weight in tons	
					Tare	Gross
1	AC FIRST CLASS SLEEPER- (EOG)	LWFAC	LA90003ALT „a“	24	40.87	43.34
2	AC FIRST CLASS SLEEPER- (SG)	LWGFAC	LA90006ALT „NIL	24	45.90	50.70
3	AC SECOND CLASS SLEEPER- (EOG)	LWACCW	LW90006ALT „NIL	54	41.60	46.72
4	AC SECOND CLASS SLEEPER- (SG)	LWGACCW	LW90011ALT „NIL	54	48.00	55.04
5	AC THREE TIER CLASS SLEEPER- (EOG)	LWACCN	LE90009 ALT „NIL“	72	43.00	48.80
6	AC THREE TIER CLASS SLEEPER- LACCN (SG)	LWGACCN	LE90008 ALT „a“	72	50.50	58.50
7	AC DOUBLE DECKER AC CHAIR CAR (EOG)	ACCC DOUBLE DECKER	LD90009 ALT „NIL“	120	48.5	65
8	AC HOT BUFFET CAR	LWCBAC	LH90001 ALT „NIL“	15	42.20	48.20
9	NON AC SECOND CLASS GS (EOG)	LS4	LG90001 ALT „NIL“	100	35.29	50.49
10	NON AC SECOND CLASS THREE TIER–(SG)	LWGSCN	LS90002 ALT „NIL“	78	36.28	42.91
11	NON AC- LUGGAGE CUM GUARD VAN(SG)	LGSLR	LR90001 ALT „a“	36	35.40	44.50
12	AC CHAIR CAR EXECUTIVE CLASS	LWFCZAC		56	42.27	48.51
13	AC CHAIR CAR	LWSCZ AC		78	42.27	50.27
14	GENERATOR CUM LUGGAGE& BRAKE VAN	LWLRRM		5(4CREWS+1GUARD)	52.12	56.78



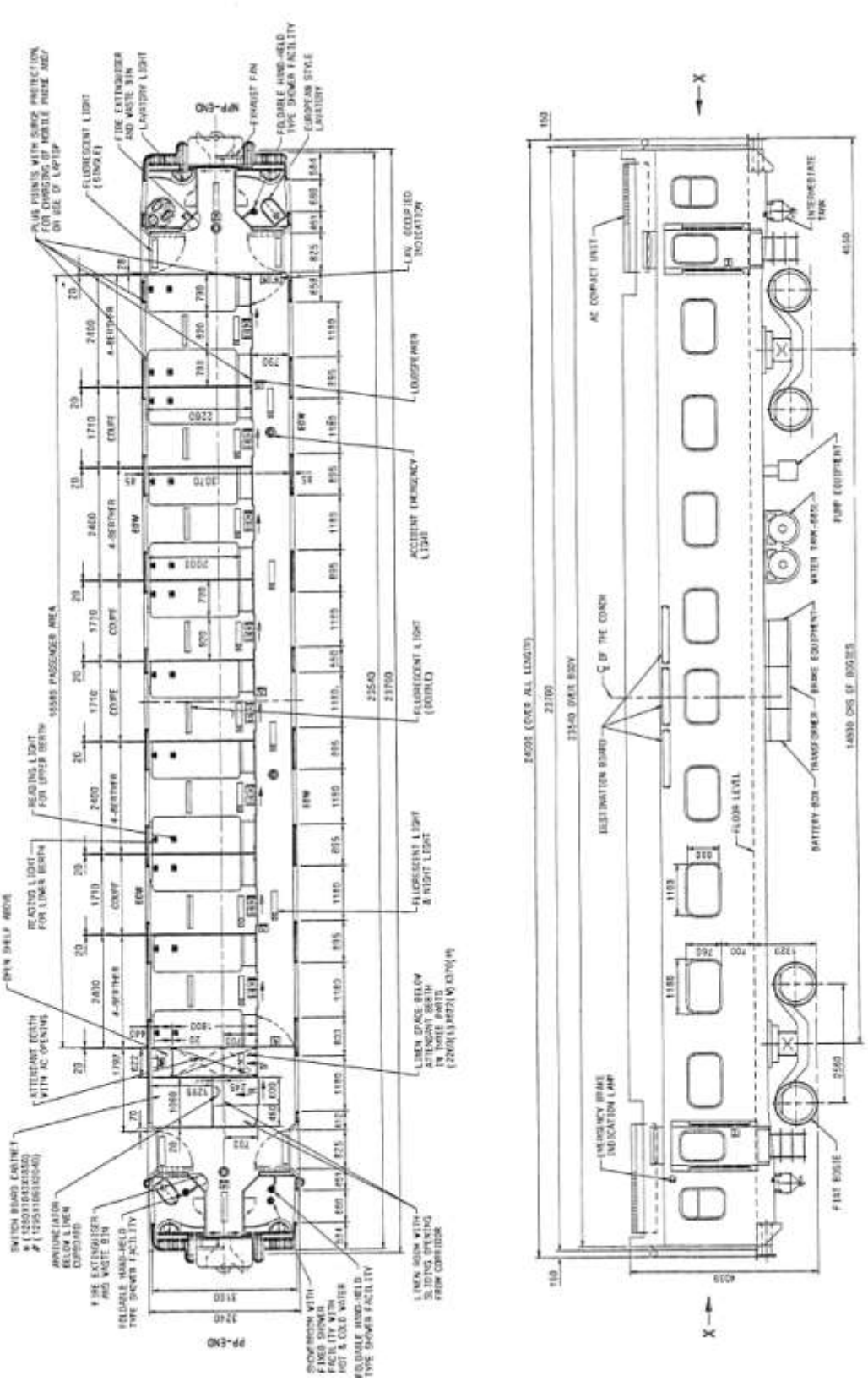
LAYOUT OF COMPOSITE 1st AC & AC TWO TIER (EOG) LHB COACH



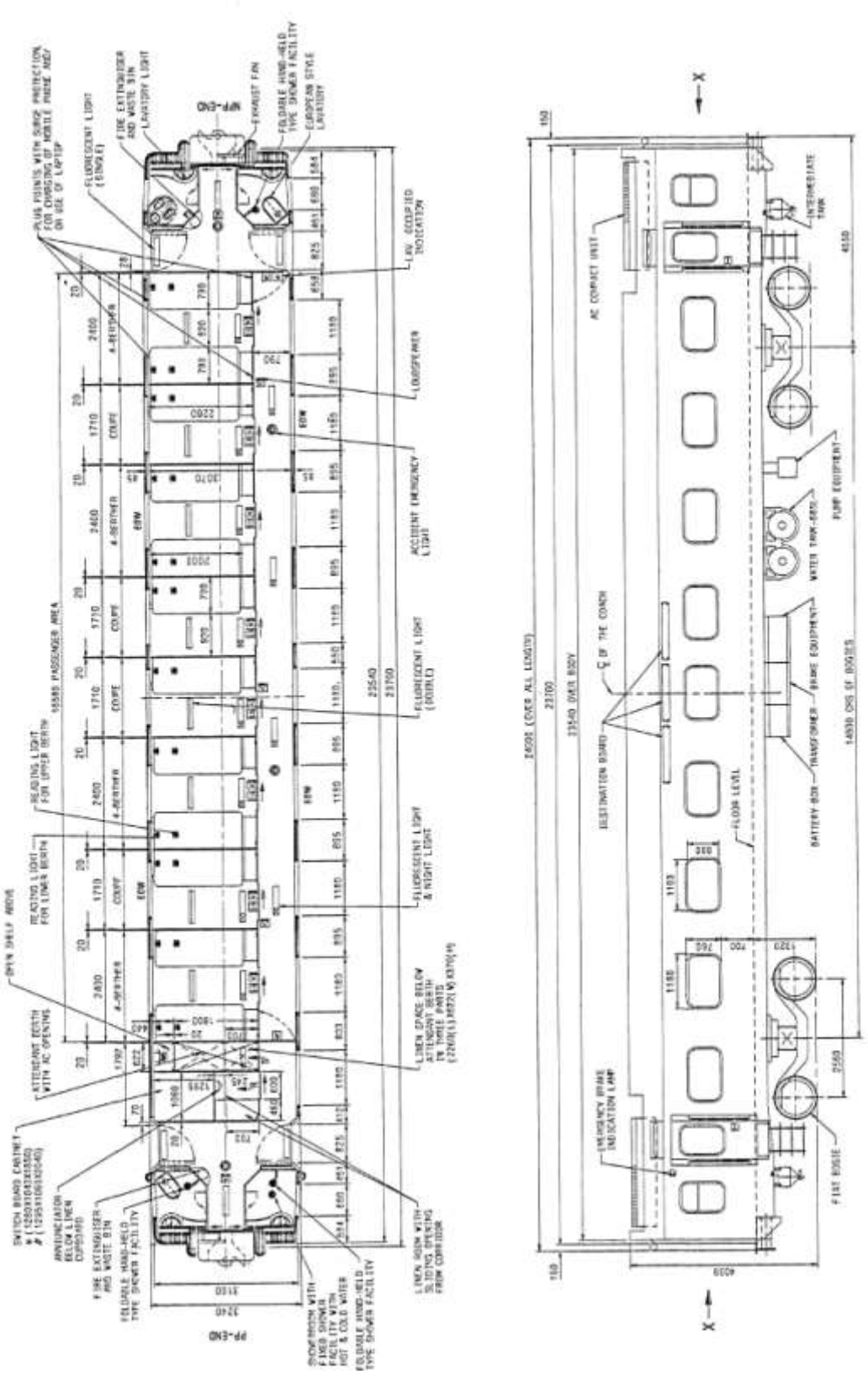
LAYOUT OF SECOND CLASS SLEEPER (EOG) SCN COACH 80 BERTHER



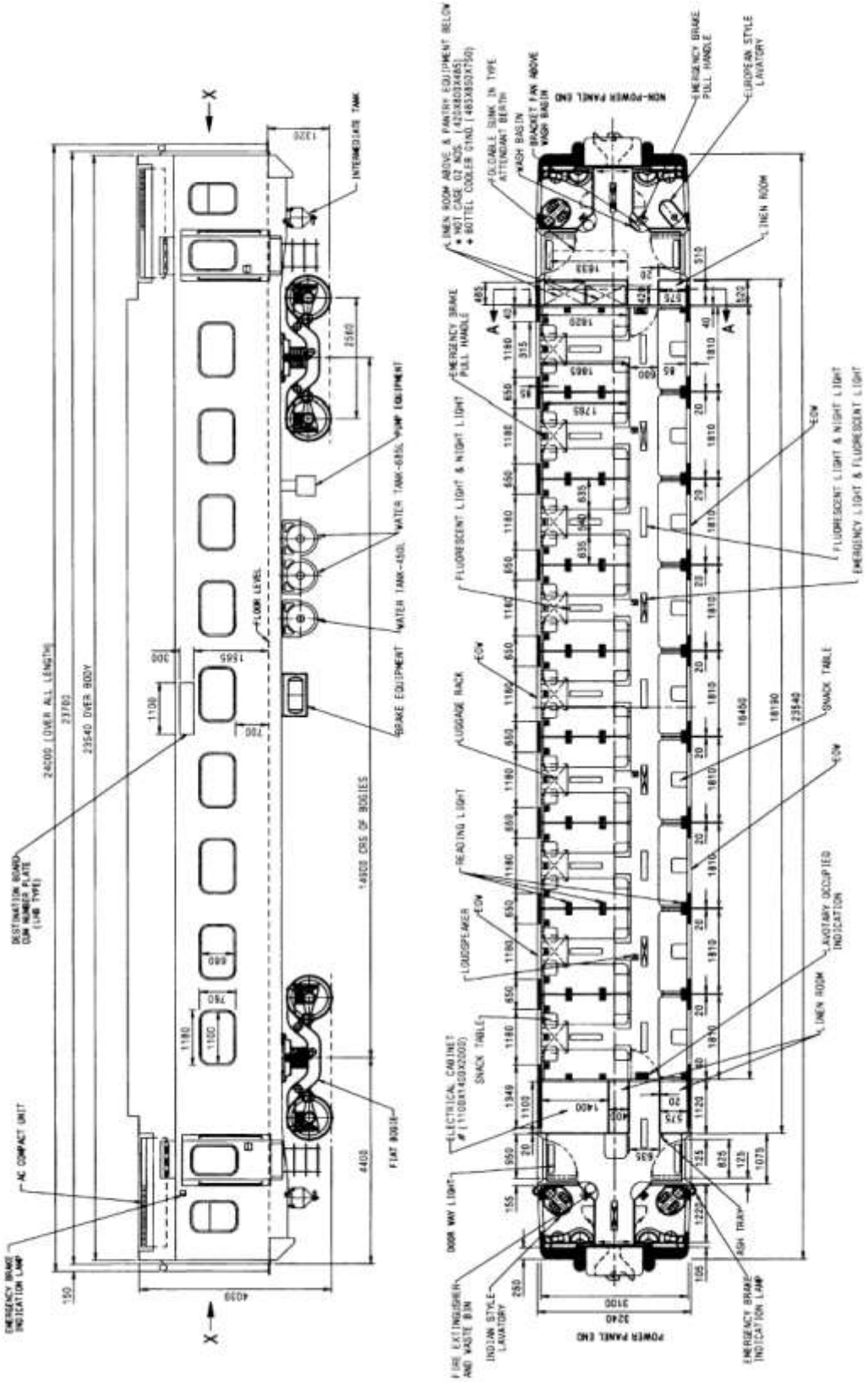
LAYOUT OF GS COACH (EOG) 100 SEATERS (LHB SHELL ON FIAT BOGIE)



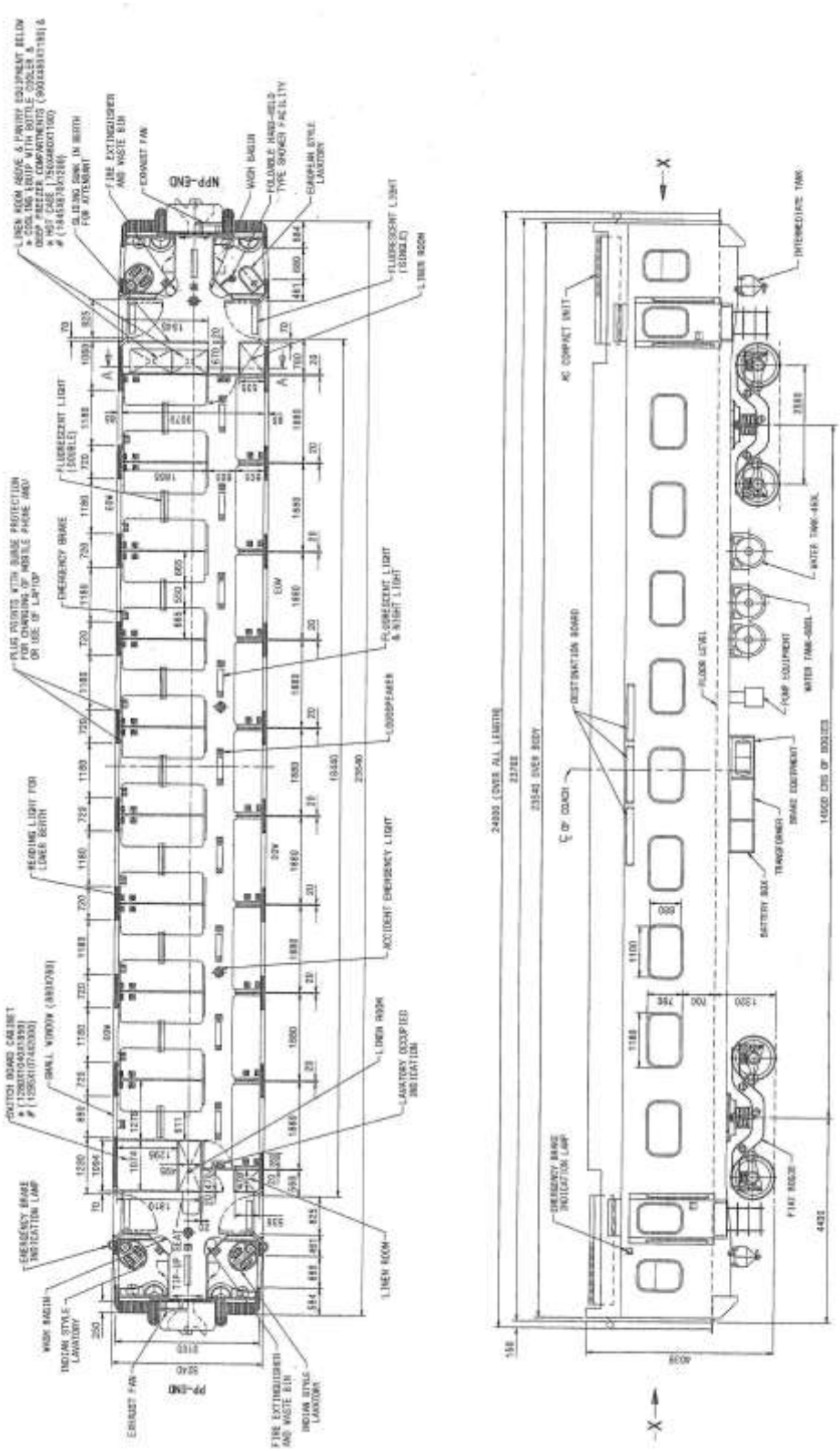
LAYOUT OF AC FIRST CLASS (EOG) LHB TYPE COACH



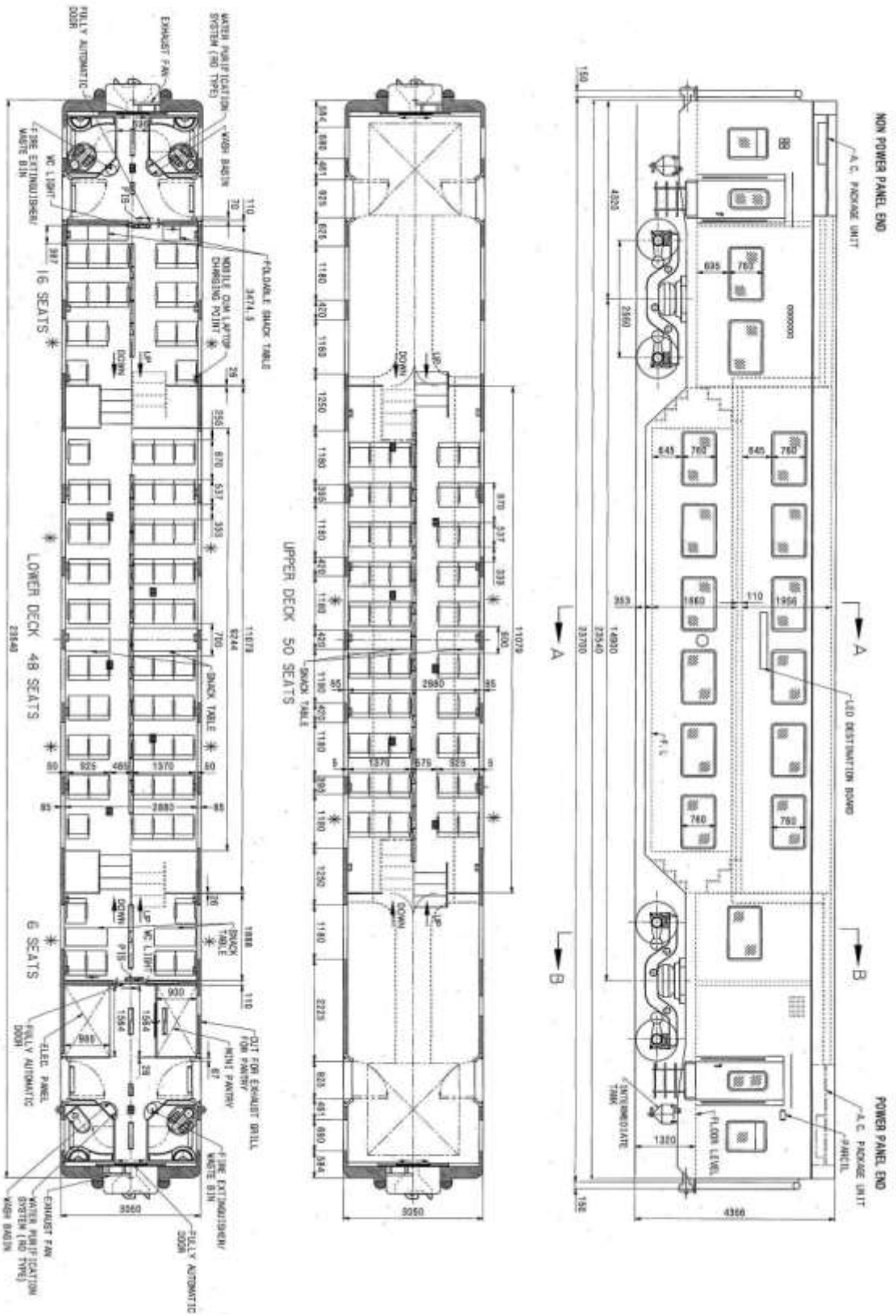
LAYOUT OF AC FIRST CLASS (EOG) LHB TYPE COACH



LAYOUT OF AC THREE TIER (EOG) LHB TYPE COACH



LAYOUT OF AC TWO TIER (EOG) WITH WIDER CABIN WIDTH LHB TYPE COACH



LAYOUT OF HIGH CAPACITY DOUBLE DECKER AC CHAIR CAR (EOG)

IMPORTANT DIMENSIONS OF VARIOUS LHB COACHES

1. COMPOSITE 1st AC & AC TWO TIER (EOG) LHB COACH

SN	Description	Parameters
01	No of passenger to sit/sleep AC 1st	10
02	No of passenger to sit/sleep AC IInd	28
03	No of lavatories	04
04	Approx. Linen capacity	2.9 cubic meter
05	Length over body	23540 mm
06	Length over CBC	24000 mm
07	Height of the coach from rail level	4039 mm
08	Maximum width over body	3240 mm

2. SECOND CLASS SLEEPER (EOG) SCN COACH 80 BERTHER

SN	Description	Parameters
01	No of passenger to sit/Sleep	80
02	Door aside	02
03	No of lavatories	04
04	Length over body	23540 mm
05	Length over CBC	24000 mm
06	Height of the coach from rail level	4039 mm
07	Maximum width over body	3240 mm

3. GS COACH (EOG) 100 SEATERS (LHB SHELL ON FIAT BOGIE)

SN	Description	Parameters
01	No of passenger to sit	100
02	Door aside	03
03	No of lavatories	04
04	Length over body	23540 mm
06	Length over CBC	24000 mm
07	Height of the coach from rail level	4039 mm
08	Maximum width over body	3240 mm

4. AC FIRST CLASS (EOG) LHB TYPE COACH

SN	Description	Parameters
01	No of passenger to sit/Sleep	24
02	Door aside	02
03	No of lavatories	03 (02 European and 01 Indian style)
04	4- Berther	04 Nos.
05	Cope	04 Nos.
06	Approx. Linen capacity	1.7 cubic meter
07	Length over body	23540 mm
08	Length over CBC	24000 mm
09	Height of the coach from rail level	4039 mm
10	Maximum width over body	3240 mm

5. AC THREE TIER (EOG) LHB TYPE COACH

SN	Description	Parameters
01	No of passenger to sit/Sleep	72
02	Door aside	02
03	No of lavatories	04
04	No of passenger per door	18 Nos.
05	No of passenger per lavatories	18 Nos.
06	Length over body	23540 mm
07	Length over CBC	24000 mm
08	Height of the coach from rail level	4039 mm
09	Maximum width over body	3240 mm

6. AC TWO TIER (EOG) WITH WIDER CABIN WIDTH LHB TYPE COACH

SN	Description	Parameter
01	No of passenger to sit/Sleep	52
02	Door aside	02
03	No of lavatories	04
04	No of passenger per door	26 Nos.
05	No of passenger per lavatories	13 Nos.
06	Linen room capacity	3.00 cubic meter
07	Length over body	23540 mm
08	Length over CBC	24000 mm
09	Height of the coach from rail level	4039 mm
10	Maximum width over body	3240 mm

7. HIGH CAPACITY DOUBLE DECKER AC CHAIR CAR (EOG)

SN	Description	Parameter
01	No of passenger to sit	120
02	Door aside	02
03	No of lavatories	04
04	No of passenger per door	60 Nos.
05	No of passenger per lavatories	30 Nos.
07	Length over body	23540 mm
08	Length over CBC	24000 mm
09	Height of the coach from rail level	4366 mm
10	Maximum width over body	3050 mm

1.2 OVERALL DIMENSIONS OF LHB COACH

Gauge	1676 mm
Length over body	23540 mm
Length over CBC	24000 mm
Wheel Base	2560 mm
Maximum width over body	3240 mm
Maximum distance between inner wheels	12345 mm
Window opening	1180x760 mm
Distance between centre pivots	14900 mm
Height of compartment floor from rail level under tare condition	1303 mm
Maximum CBC drop under gross load and worn conditions	75 mm
Minimum height from rail level	102 mm
Maximum height of centre line of side CBC above rail level for empty vehicle	1105 mm
Minimum height of centre line of CBC above rail level for loaded vehicle	1030 mm
Maximum tare weight	
Wheels diameter (New)	915 mm
Maximum axle load permissible	16.25 tones
Number of toilets	3 (**for Shatabdi coaches**), there is difference in the no. of toilets for different types of coaches.
Higher speed potential	160 Kmph upgradable to 200
Ride index of coach*	2.5 at 160 Kmph but not >2.75

Maximum Moving Dimension of LHB Coaches should be within "Diagram 1D" of Schedule of Dimension BG (Revised 2004)

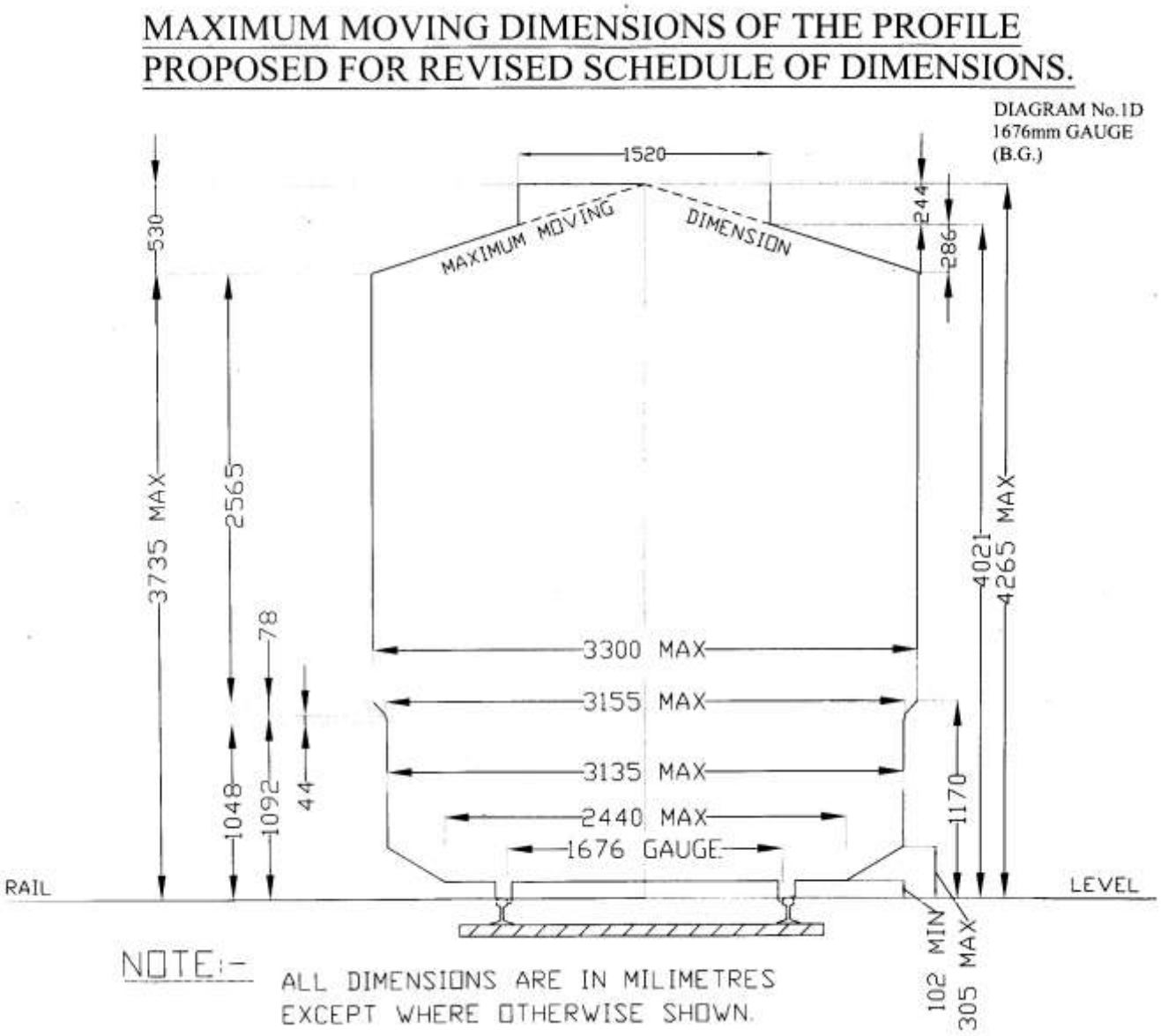
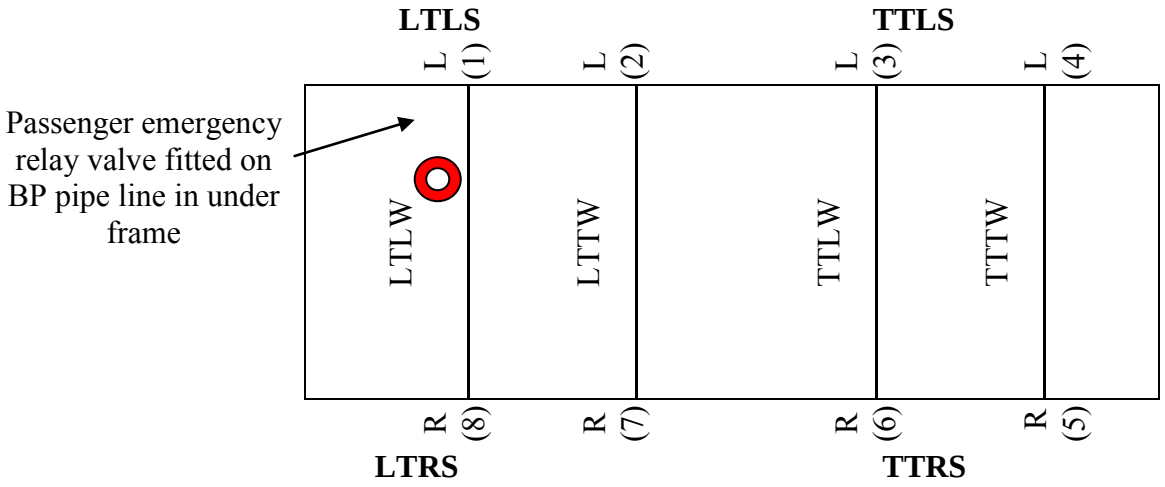


Figure: 1.1 Maximum Moving Dimension of the Profile Proposed for Revised Schedule of Dimensions

1.2.1 Figure for Numbering Axle boxes /Wheels in LHB coaches

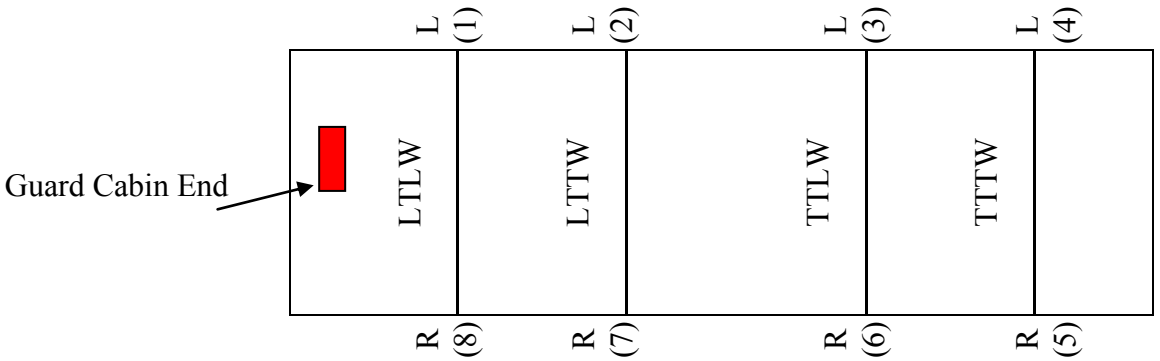
Figure A: For all type of LHB coaches other than Power Cars



Note:

1. LTLW (L) will always be counted from Passenger Emergency Relay valve fitment side.

Figure B: For LHB Power Cars:



Note:

1. LTLW (L) will always be counted from Guard compartment End & looking towards generator cabin side.

2. Bogie sides are defined as
   LTLS- Leading Trolley Left Side
   LTRS- Leading Trolley Right Side
   TTLS- trailing Trolley Left Side
   TTRS- trailing Trolley Right Side

1.3 SALIENT FEATURES

Important features of LHB coaches which make them superior to existing ICF design coaches are summarized below.

i Coach Body

LHB coach is light weight construction made from low corrosive stainless steel. The weight of the coach is about 10 percent less as compared to the conventional coach resulting into lower haulage cost. Each vehicle is equipped with complete pantry to store hot meals and cold beverages except LWLRRM, LWFAC, SCN, GS etc. The modular construction and the integration of lights into interior ceiling and luggage racks are characteristics features of modern interior design. Windows are specious and modern equipment have been provided which make the coach far superior esthetically.

ii Car body Shell :

The car body shell is of economical weight steel construction with interlocking technique developed by M/s Alstom. Roof is of beaded sheet construction and floor sheet is corrugated made of austenitic stainless steel. Roof structure, side wall and end wall are made of ferritic stainless steel. IRSM-41 CORTEN steel has been used for under frame and other parts.

1.4 HEAT AND SOUND INSULATION

- PU based spray insulation for corrosion protection and sound insulation on the interior surface of the car body shell.
- Heat insulation of the floor, side walls lower area and end walls with Resonaflex insulating mats.
- Use of Resonaflex –Alu & Baryskin V60DB in shell, de-coupling elements in flooring and elastomeric rubber-metal components in bogie results in superior noise insulation. Noise level inside coach is limited to 60 DB.

1.5 SEALED WINDOW GLASS UNIT

Three types of windows have been used in LHB coaches.

i Fixed window unit with sealed glass, 12 per coach

The sealed unit consists of outer 8.4 mm laminated glass and inner 4 mm tempered safety glass with 6 mm air gap with Krypton/Argon gas filling. Glasses are held by an aluminum extrusion frame with rubber profile. The aluminum frame is glued to the coach shell.

ii Emergency openable window: 4 per coach

Emergency window is similar to the fixed unit. Four units are provided in each coach to allow emergency evacuation of passenger. A handle is connected to the rubber profile to open the glass unit of the emergency window. The breakage of glass unit while opening is prevented by a restraining chain.

iii Hopper type windows for lavatory: 3 per coach

These windows are provided for lavatories of the LHB coaches

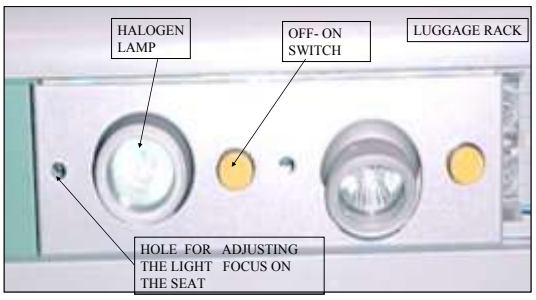
1.6 ROLLER BLINDS IN AC CHAIR CARS

Roller Blinds have been provided on the windows in AC Chair Cars instead of curtains. It is a sun protection fabric. The roller blind is manually operated. These blinds have three positions i.e. full open, half open and full closed. The wire tension enables an wrinkle free and easy use.

1.7 LUGGAGE RACKS IN CHAIR CARS

The luggage racks are made from aluminum extrusion lengths and tempered safety glass. It can withstand distributed load of 1000 N (100 kgs) per meter length and pointed load of 850 N (85 Kgs) as per UIC 566.

Halogen reading lights for individual seats, fitted into outer extrusion and wiring hidden by polycarbonate lexan sheet with fire characteristics as per DIN 551/2.



Aluminum extrusions are used with anodized finish. Side cheeks of cast aluminum alloy are provided with powder coated finish. Reading lights and movable coat hooks are provided in luggage racks.

1.8 COMPOSITE WOOD FLOORING PANELS.

For flooring, 16 mm composite board made from cork panels glued to "MakeOre" wood have been used. Flooring panels are lightweight, strong, warp resistant and also resistant to vibration/impact forces. These boards are specially treated for fire resistance. These are also resistant to moisture, cigarette burns, staining, ageing, etc.

1.9 SEATS IN CHAIR CARS

There are 78 chairs in the II AC chair car and 56 chairs in Executive class chair car. Weight of a single chair car for II AC chair car is approximately 21 kg against 28 kg in existing IR coaches.

The height of the seat cushion above floor level (450 mm), the width between the arm rests (420 mm in chair car and 500 mm in Exe.class) and the ergonomically designed upholstery provides excellent seat comfort without causing tiredness even on long journeys.

Main assembly comprises –

- Welded seat frame
- Seat cushion
- Sleeplessly inclinable backrest (17 degree in upright and 37 degree in rest position)
- Arm rest
- Foldable table with bottle holder
- Foot rest
- Magazine net

There are 24 berths in First AC, 52 berths in AC 2 tier and 72 berths in AC 3 tier.

1.10 PASSENGER EMERGENCY ALARM

In the earlier version of Chair Car coaches, 5 passenger emergency alarms per coach were provided at following locations:

- 2 in passenger compartment
- 3 in lavatories.

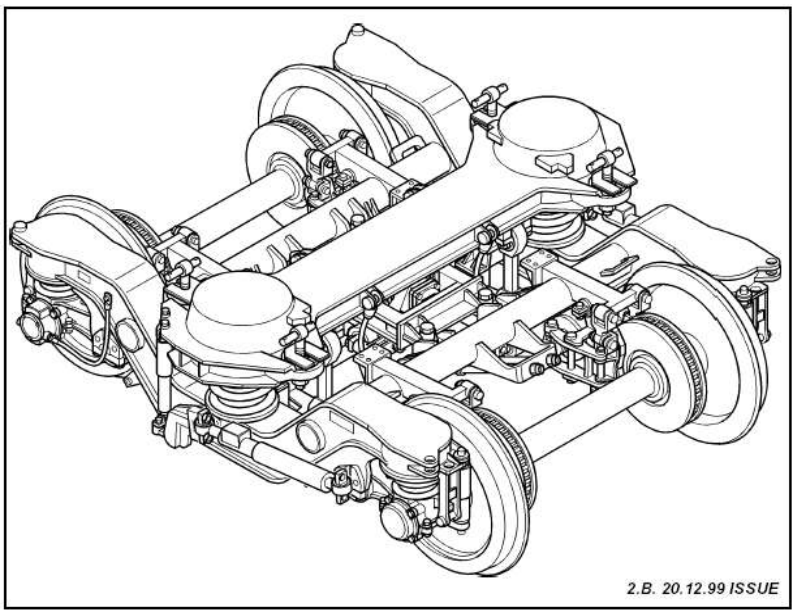
However in the present version of chair cars, these alarms are provided only at two locations and in Ist AC, 2 tire , 3 tire & sleeper coaches, Passenger Emergency Alarm is provided in every bay.

1.11 COACH LIGHTING

Fluorescent tubes are used for general lighting, vestibule, toilet, pantry and emergency working at 110VoltsAC/DC with inverter and polycarbonate diffusers.

Fluorescent tubes	18 watts
Incandescent lamps	10 watts (for night lamp and pantry)
Halogen lamps	10 watts (reading lights)

1.12 FIAT - BOGIE



The FIAT (Fabrica Italina de Automobil Torino) bogie is an adoption of EUROFIMA design. This bogie belongs to the two-axle type, with a primary and a secondary suspension The bogie frame consists of two side members of Y-shaped longitudinal beam connected by two tubular steel members. The Y shaped side members consist of structural steel and welding is done to form box sections. Minimum strength of the structure is 52 kg/mm^2 with D class weld. Bogie is designed for maximum operating speed of 160 kmph and has potential for operation upto 200 kmph. Axle guidance is provided by an articulated control arm through a resilient bush.

This is a two stage suspension bogie. The car body directly rests on the secondary stage helical springs, which rests on Y shaped side beam. The bogie frame rests on primary stage helical spring which are resting above the axle box crown. The tracking and braking force from axle to bogie frame is transferred through articulated control arm system of primary suspension.

Bogie is capable to permit the coach body to negotiate curve of 175 m radius at maximum speed potential of 40 kmph and 1 in 8 $^{1/2}$ turn out in either direction at 30 kmph.

1.12.1 Dampers

Each FIAT bogie uses 4 primary vertical, 2 secondary vertical, one secondary lateral and 2 yaw dampers. These are hydraulic shock absorbers to damp the accelerations caused due to track irregularities and opposing force depending on the speed of the movement (Complete details of damper is given chapter 4).

1.12.2 Axle bearing

LHB use TIMKEN & SKF make taper roller cartridge type bearings. These are self contained, preassembled, pre-lubricated and are totally enclosed to avoid manual handling. These are applied and removed from the axles without exposing the bearing elements or lubricant to avoid contamination or damage. The axle bearings on the bogie are fitted with sensors for detecting speed (whose signal is elaborated by the anti slipping system) and a current return device. The axle bearing is a maintenance free bearing. The overhaul cycle is 1.2 million km.

1.12.3 Anti-roll bar

A torsion bar having two forks is provided between bogie frame transverse beam with the help of two links to resist rolling motion of coach.

1.12.4 Rocker device

The traction and braking force between bogie and body is transferred through a rocker device located at the center of the bogie approximately in the plane of axle.

1.12.5 Body-bogie connection

A special type of body-bogie connection has been provided between coach body and bolster.

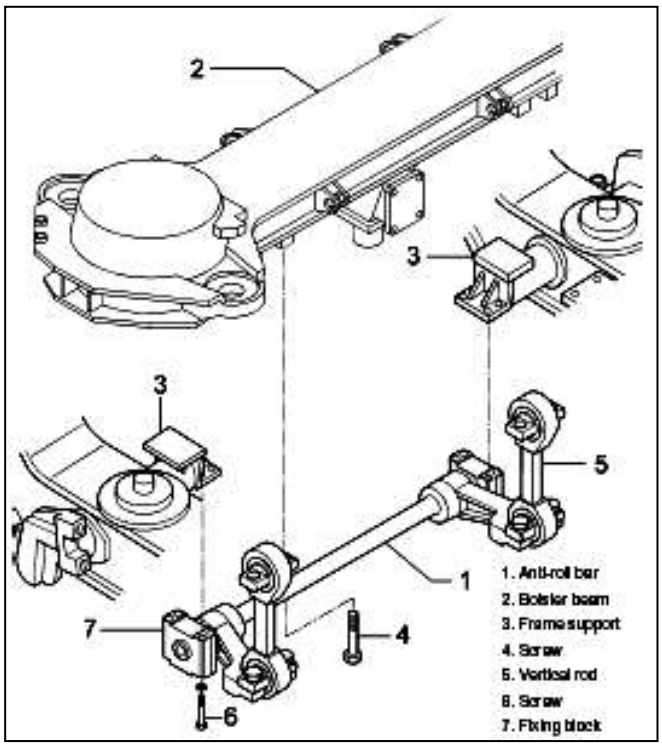


Figure: 1.2 Anti-Roll Bar

This connection consists of disc spring, hemispherical ball, swinging link pin, link pin, etc.This connection is capable to cater for the acceleration value up to 0.5g in lateral and longitudinal direction. Beyond that value, a bracket comes into action between bogie bolster and coach body.

1.12.6 Force transmission

Vertical forces:

BODY-SECONDARY SPRINGS - BOGIE FRAME - PRIMARY SPRINGS/BALL JOINT CONTROL ARM - AXLES.

Lateral forces:

BODY – SECONDARY .SPRINGS - BOGIE FRAME - BALL JOINT CONTROL ARM- AXLES

Longitudinal traction efforts and braking powers:

BODY-TRACTION CENTRE -TRACTION RODS -TRACTION LEVER-BOGIE FRAME-CONTROL ARM-AXLES

1.13 CENTER BUFFER COUPLER (CBC)

The coupler provides a means of mechanically connecting individual adjacent vehicles to make a train. The coupler is located at both ends of each vehicle. When connected to a coupler of an adjacent vehicle, it allows the vehicles to move independently to accommodate track curvature and elevation change while remaining connected (coupled) together.

The coupler is opened manually using the coupler operating rod and is closed automatically when the couplers on adjacent vehicles are mated. The coupler automatically locks when fully mated.
LHB coaches have been provided with tight lock centre buffer couplers instead of screw coupling.

Couplers are AAR-H type and have anti-climbing features because of vertical interlocking. Couplers have adequate strength for:

- Satisfactory hauling of a train of 26 coaches at 110 kmph
- Satisfactory hauling of a train of 18 coaches at 160 kmph

Coupling is possible under angular misalignment both horizontally and vertically. The coupler permits coupled trains to negotiate vertical and horizontal curves and allows rotational movements. The draw gear ensures cushioning effective in both buff and draft.

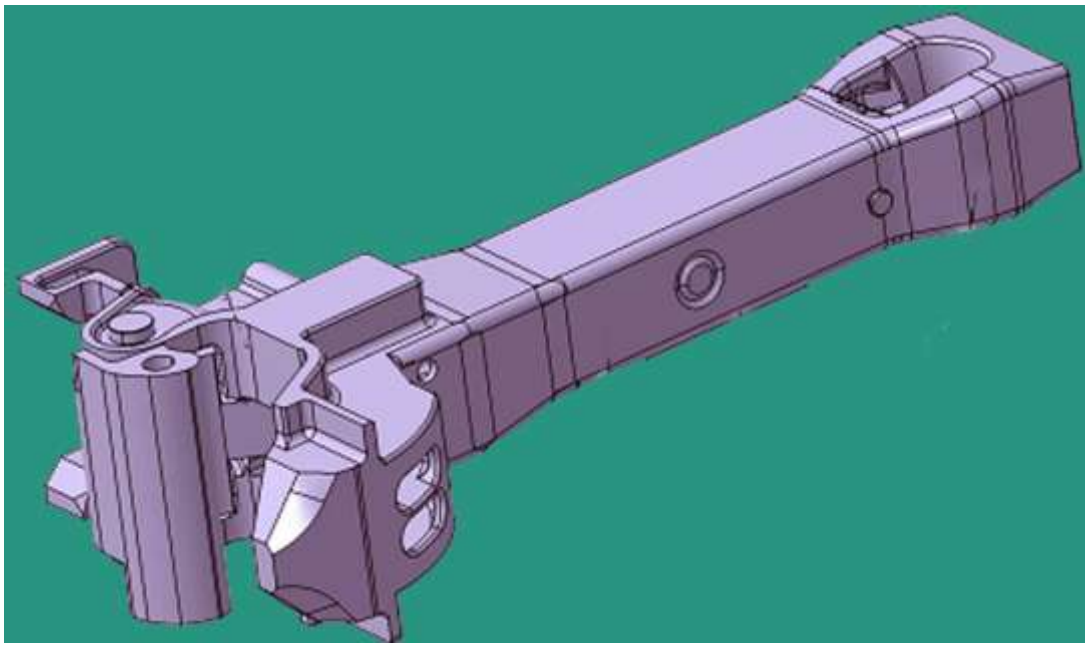
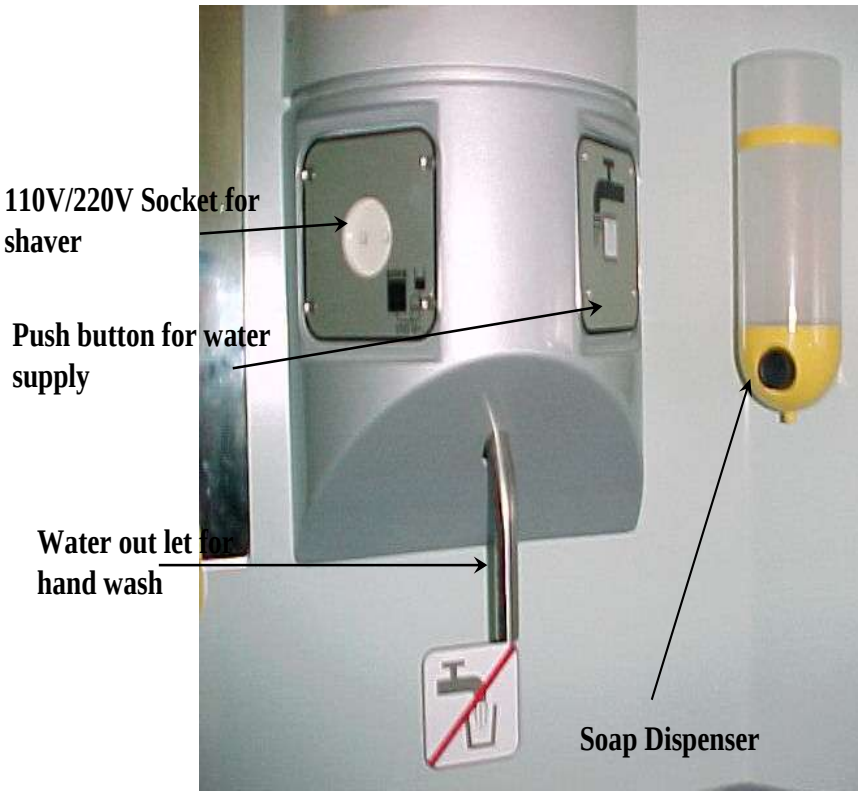


Figure: 1.3 Centre Buffer Coupler

1.14 LAVATORIES

LHB coaches have both Oriental and European type of lavatories with controlled discharge toilet system. The salient features of LHB modular toilets are illustrated below:



1.15 CONTROLLED DISCHARGE TOILET SYSTEM (CDTS)

LHB coaches are fitted with controlled discharge toilet units to avoid soiling of track in station and inhabited areas.

The toilet system is designed to operate with a pressurized water bowl wash that covers 100% of the toilet bowl area. The waste is removed from the toilet bowl and transferred to a retention tank with minimal amount of water. Water consumption is only 2.5 liters per flush cycle for the Indian style toilet bowl and 1.5 liters for the European style toilet bowl. In future, Bio toilet tanks will be provided in the LHB coaches in place of CDTS.

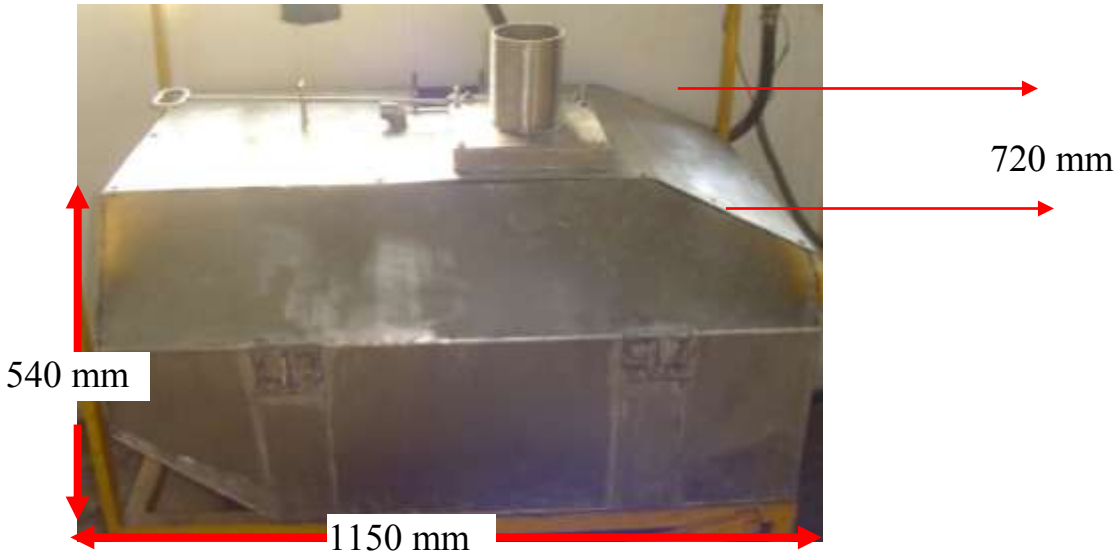
1.16 IR-DRDO BIO-DIGESTER TANK FOR COACHES

These tanks are made of stainless steel and having following constructional features:-

The size of the tank is 540 X 1150 X 720 MM with the provision of 04 nos mounting brackets at both the sides along the length of the tank. Each bracket is with the provision of 02 nos. M16 Size bolts which are tighten in the under slung on mounting brackets.

Main parts of the Bio digester tank:

1. Stainless steel tank with 06 partition walls in side the tank
2. Poly grass mats for protection of bacteria in side the walls.
3. Ball valve with handle for operation during emergency for making toilet direct discharge in case of chocking.
4. SS fasteners in place of MS on tank covers.
5. Stronger bonding of Colonized rubber mat with vertical walls.

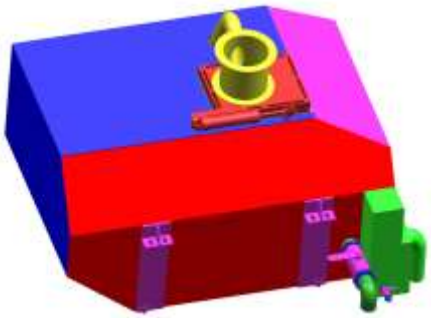


Important Dimensions & Volume of Bio digester Tank:

1. Length - 1150 mm 2-Width - 720 mm, 3. Height – 540 mm
4. Total Volume of Tank – 400 lt. 5. Effective Volume of Tank – 300 it.
6. Empty Tank weight – 110 Kg. 7. Full Tank Weight – 410 Kg.
8. Height from rail level – 225 mm.

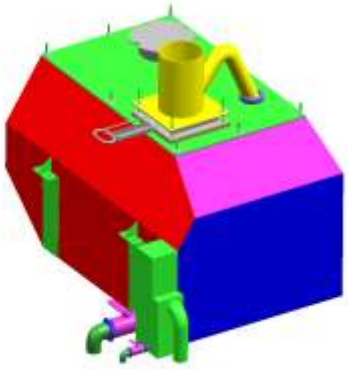
Different variants of Bio toilets:

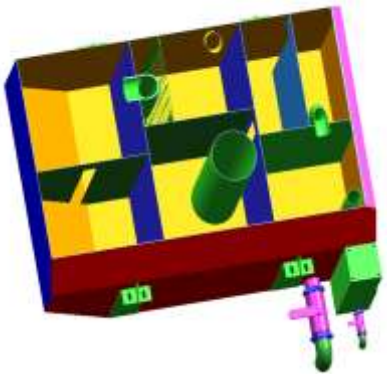
Brief description	Features			
	Pneumatics	**Electrics**	**PLC**	**Flush**
System with flapper valve	Yes	Yes	Yes	Pressurized
System with manual slider valve	no	no	no	gravity
System with reduced opening at inlet For western style Hindware commode is proposed	no	no	no	gravity
System with solid liquid separator	no	no	no	gravity



Variant-I

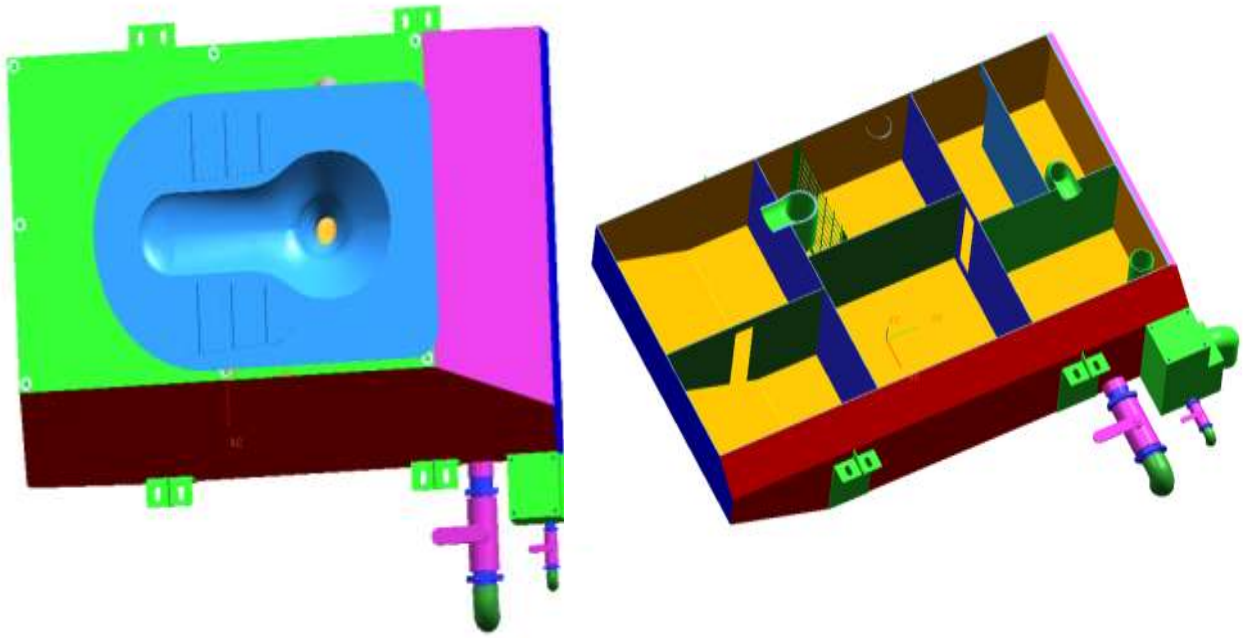
Fail safe mode exist- chute system can be operated without dismantling of tank



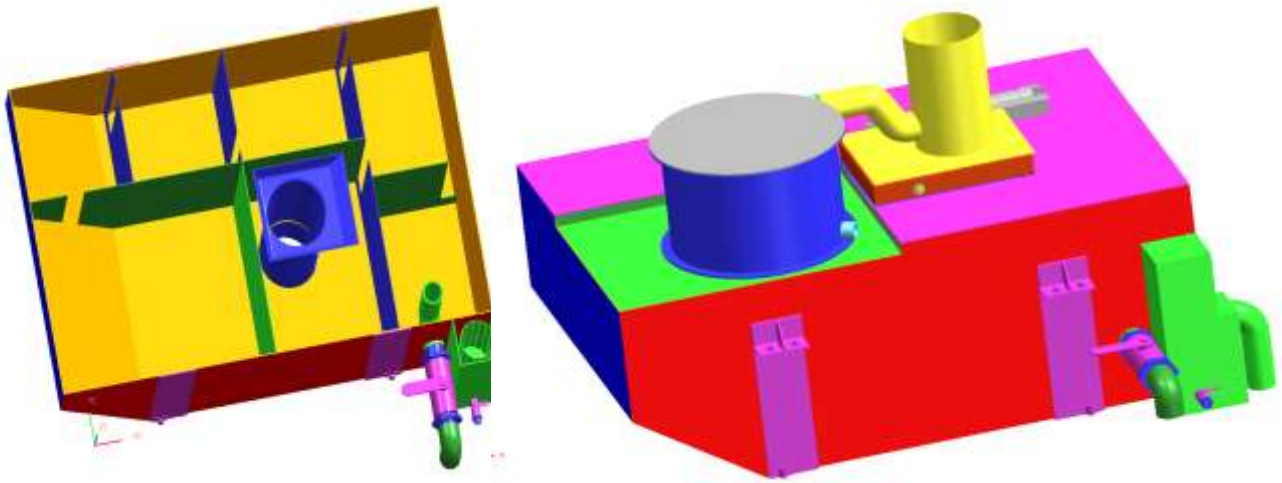


Variant-2

Fail safe mode exist- chute system can be operated without dismantling of tank



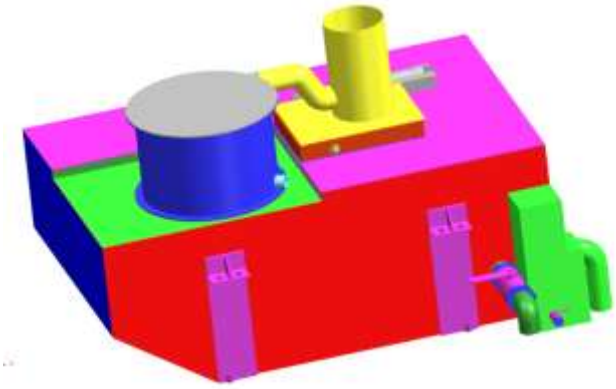
Variant-3
Fail safe mode does not exist

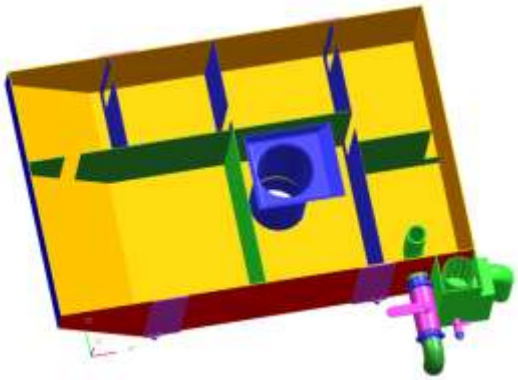


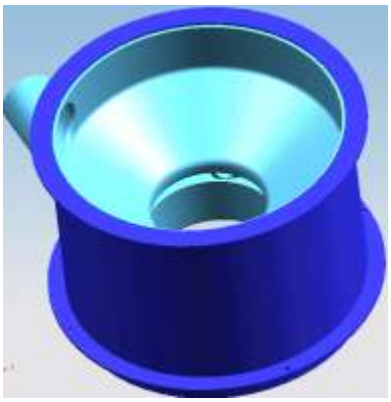
Variant-4
Fail safe mode exist- chute system can be operated without dismantling of tank

Brief about variant 4 with PLC fitted at ICF

Brief description	Features			
	Pneumatics	**Electrics**	**PLC**	**Flush**
System with Solid liquid separator **with the provision of Ball valve.**	Yes	Yes	Yes	Pressurized







Bio toilets with Ball Valve

1.17 OTHER ELECTRICAL EQUIPMENT

Following electrical equipments have been provided in all the Chair car coaches.

- Pantry
- Soup Warmer
- Hot case
- Refrigerating Unit

NOTE

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CHAPTER 2

LHB SHELL

2.0 GENERAL

The LHB Coach is of integral light weight construction, consisting of separate assembly group for under frame, side walls, roof and end walls. The individual assemblies are joined to each other by welding. Three types of steel are used for manufacture of body shell.

Shell Assemblies	Steels used and their %age compositions	UTS N/mm^2	Yield Stress N/mm^2
Side wall, End wall and Roof structure	X2Crni12 Ferritic steel (SS 409M) (C</= .03%, Cr 10.5-12.5%, Si 1%, Mn0.5-1.5%	450-600	320
Roof sheet and Trough floor	X2CrNi1810 Austenitic steel (SS 304) (C </=0.07%, Cr 17-19%, Si 1% max , Mn2.0% max)	550-750	235
Under frame	IRS M-41 / Corten Steel (C 0.01% max, Cr 0.35 -0.6%, Ni 0.2 - 0.47% Cu 0.3 - 0.6% Si 0.28 -0 .72%, Mn0.25 to 0.45%)	440-480	320

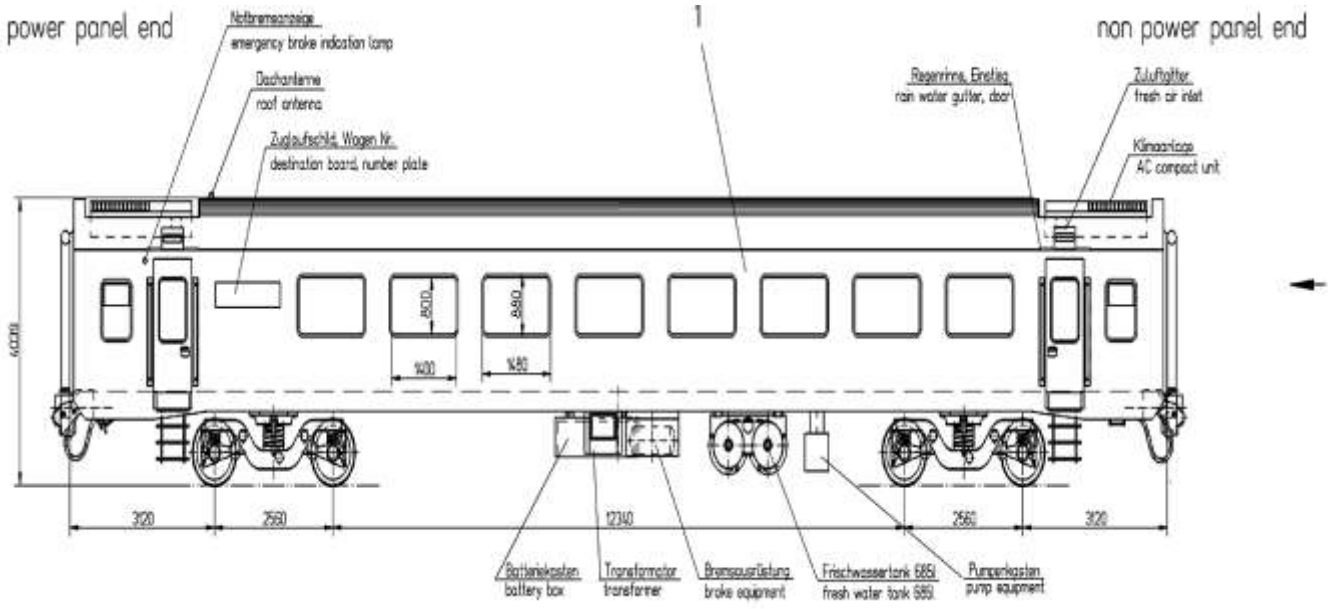


Figure: 2.1 view of LHB Coach

The important features of body shell which make it superior to conventional ICF shell are described below.

2.1 HEAT AND SOUND INSULATION

With regards to heat and sound insulation, LHB shell is far superior to ICF shell. PU based spray insulation is provided on the interior surface of the car body shell for corrosion protection and sound insulation. Heat insulation of the floor side wall lower area and end wall is done with Resonaflex insulation mat. Use of Resonaflex ALU and Bary skin V 60 DB in the shell, decoupling element in the flooring and elestomaric rubber metal components in bogie results in superior noise insulation. The noise level inside the coach is limited to 60 DB.

2.2 DETAILS OF HEAT INSULATION

	Type/Location	Thickness
1.	Glass Wool for Roof, side wall, end wall (above window bottom level)	60 mm
2.	Resonaflex Roof, side wall, end wall, (below window bottom level	60 mm
Technical details of Resonaflex Alu are:		
	Size of sheet	1000x1000 $^{+10}/_{-20}$ mm
	Thickness	20 mm to 100 mm with 5 mm steps
	Cubic weight	28.0 kg/m^3
	Fire response	Conforms to B-1 of DIN 4102/5510

2.3 DETAILS OF SOUND INSULATION

Location	**Thickness**
Roof, side wall and end wall	2-3 mm
Floor near bogie(inside)	6-8 mm
Floor residual region	2-3 mm
Floor outside (thick coat)	100 micron

Roof sheets are manufactured from 1.25 & 1.7 mm thick austenitic stainless steel, roof arches are manufactured from 2 mm ferritic stainless steel, end plate and angle are manufactured from 4 mm ferritic stainless steel. The middle portion of roof sheet is plain and manufactured from 1.7 mm austenitic stainless steel.

All items of end wall are manufactured from 2, 2.5, 3 and 4 mm ferritic stainless steel except console which is manufactured from 6 mm carton steel plate.

2.4 SIDE WALL

The side walls are manufactured by TIG Welding of sheets to achieve low heat inputs, less distortion and negligible shrinkage. The thickness of side wall sheets is 2 mm. The other important features are:

- Door frames are part of sub-assembly of side wall but fabricated separately to take up compensation of tolerances in whole side wall.

- Positive interlocking between all horizontal and vertical members
- Reduced side wall thickness of 60 mm from 90 mm.
- Better geometric integrity and strength.

Side wall is welded with under frame by V grooving of sole bar. Meta cot silver grey weld able primer is applied to avoid bimetallic corrosion. The welding is done by magnetic track welding and grinding of welded joint is done to ensure smoothness. The design of side wall has eliminated turn under to avoid accumulation of water; muck and resultant corrosion. The approach for sand blasting and painting is better.

2.5 END WALL

End wall is made of ferritic steel. To reduce its weight holes provided in all stiffeners. The projection of side walls towards end is more. This results into more availability of space for passengers and reduction in the gap between two coaches, thereby reduced wind gap resistance and turbulence. The gap between two end walls is 300 mm only.

Figure: 2.2 Shell Structure

2.6 ROOF

Roof sheets are manufactured from 1.25 & 1.7 mm Austenitic stainless steel. Roof arches are manufactured from 2mm Ferritic steel. End plate and angles are manufactured from 4 mm Ferritic steel. The middle portion of roof sheet is plain and manufactured from 1.7 mm Austenitic steel. The roof is light weight as compared to ICF coaches.

2.7 UNDER FRAME

Main Components of Under Frame are:

- Front part made by joining head stock and body bolster.
- Two side sills of sole bar of AC Chair car are made of section 238x65x6.
- Two side sills of sole bar of AC Power car are made of section 238x65x8.
- Two side sills of sole bar of both above coaches are made of section 238x65x4
- Two main cross members - 6 mm thick
- Frame – cross members made of folded

channel sections 140x50x4

- Floor is made of corrugated sheets of 1.25 mm thickness
- Corrugated trough floor is plug welded from top with the cross members.

Water tank mounting brackets are welded on the under frame

YAW DAMPER (connected between under frame and bogie frame) brackets are welded on the under frame

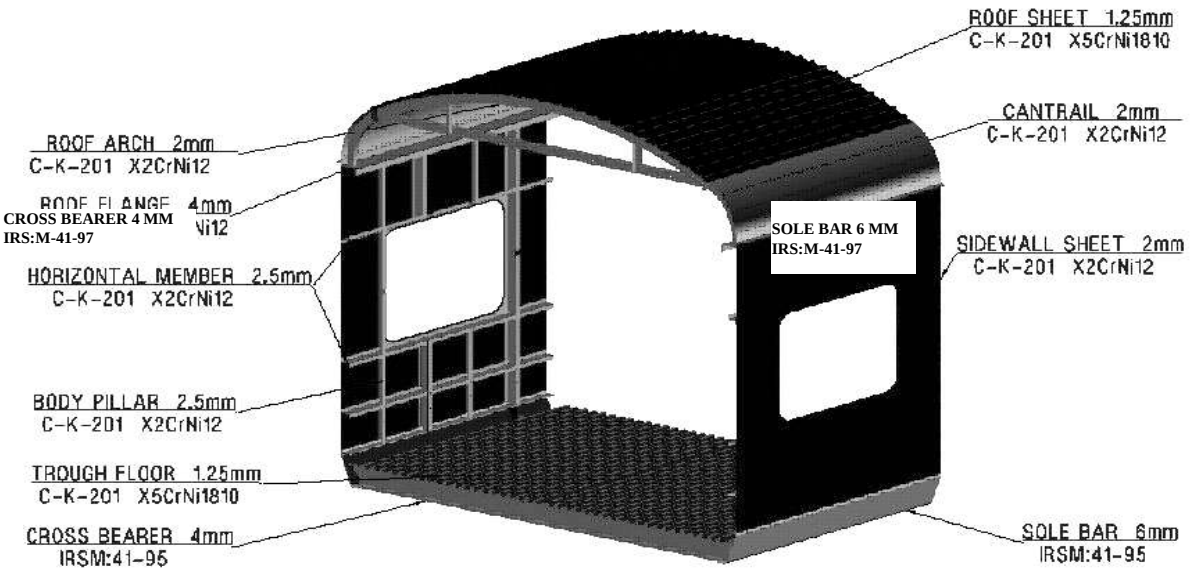


Figure: 2.3 Diagram Showing Various Sections of Shell

2.8 CODAL LIFE OF COACHES

Codal life can not be fixed at present as sufficient data is not available in this regard. The Codal life of ICF coaches is 25 years and this coach is likely to have a higher codal life. However, this should be finalized after zonal Railways get sufficient experience.

2.9 PERIODICITY OF MAINTENANCE SCHEDULES

TABLE-1

Schedule	Periodicity
Trip Schedule D1	Every Trip/Weekly
Monthly Schedule/D2	30 days ± 3 days
Six Monthly Schedule/D3	180 days ± 15 days
(Shop Schedule I) /SS-I	18 Month±30 days/6 Lakhs Kms earned whichever is earlier
Shop Schedule II / SS-II	3 Years/12 Lakhs Kms earned whichever is earlier.
Shop Schedule III /SS-III	6 Years/24 Lakhs Kms earned whichever is earlier.

2.9.1 Periodical Overhaul

- The general sequence of work during Shop Schedules of a coach is given in a typical PERT chart as shown in Annexure 2.1
- Modifications in LHB type BG coaching stock is given in CAIs issued by RCF/KXH. The list of these CAIs is in appendix-A.

2.9.2 Method of Repairing

Lifting the Coach Body

a) On receipt of a coach for Shop Schedule, it must be taken on Lifting line/ Stripping line where electrical fittings should be stripped and batteries removed. Furnishings, especially seats and backrests should be inspected thoroughly and only those that require repairs or attention should be removed.

b) Before lifting a coach, the following components should be removed, disengaged or disconnected:-

(i) Wheel sets earthing equipment.

(ii) Speed sensor cover.

(iii) Yaw Dampers.

(iv) Secondary Lateral Damper.

(v) Roll Link from Bolster.

(vi) Wire rope pin from Bolster.

(vii) Hose connection from Bogie to coach.

(viii) Centre pivot security plate.

(ix) Bolster from coach body by means of removing nut & swing nut.

(x) All air brake fittings

(xi) Control arm bottom cover

(xii) Centre Buffer Couplers etc.

(xiii) CDTS

(xiv) Under slung water tanks & Water Raising Apparatuses (WRA), where provided.

(xv) Battery box and electrical fittings.

(xvi) AC equipment in AC coaches.

c) Coach body should be lifted off the bogies either by two overhead electric cranes of 25 tonnes capacity each with suitably designed lifting tackles or by four powered lifting jacks of 15 tonnes capacity each operated simultaneously by one control switch. The coach body should be lifted uniformly without jerks and should remain horizontal during the lifting/ lowering operation. Coach should not be lifted from any point other than at the lifting pads as shown in figure 2.5.

d) The coach should never be lifted from one end only. If lifted from one end, the Centre pivots security plate is likely to suffer damages, body panels are likely to get dented near the body bolster. The sealed windows of AC coaches are also likely to break.

e) After the coach body is lifted, it should be kept on trestles. The steel trestles of the design shown in Figure 2.4 would prove useful for this purpose Lines should be protected by scotch blocks with locking arrangement and key should be kept with Engineer till the time maintenance work is carried out.

f) The entire under frame should be cleaned of dust, rust etc. from underneath by pneumatic/water jet followed by wire brushing at critical locations and check for cracks/damage, corrosion etc. on the under frame members**.**

g) After carrying out all repairs, the under frame should be painted.

2.9.3 Maintenance during Shop Schedule-I

i) All bogies of LHB coaches shall be given SS-I after **18 months ± 15 days** from the date of last Shop Schedule as per table 1.

ii) During this schedule, bogies/under frame members and body including trough floors should be thoroughly examined and all parts of running gears are repaired/ replaced as necessary.

iii) The detailed of maintenance activities to be carried out during SS-I schedule, please refer Chapter 12 of this manual.

iv) The date of this schedule should then be stenciled at the appropriate place in schedule chart on the end panel.

2.9.4 Lowering the Coach Body

a) After all the repairs are carried out refit all repaired sub-assemblies which are removed for maintenance and lower the coach body on the overhauled and tested bogies.

b) The securing arrangement of Centre plate should be fitted into position and secured by means of necessary fittings.

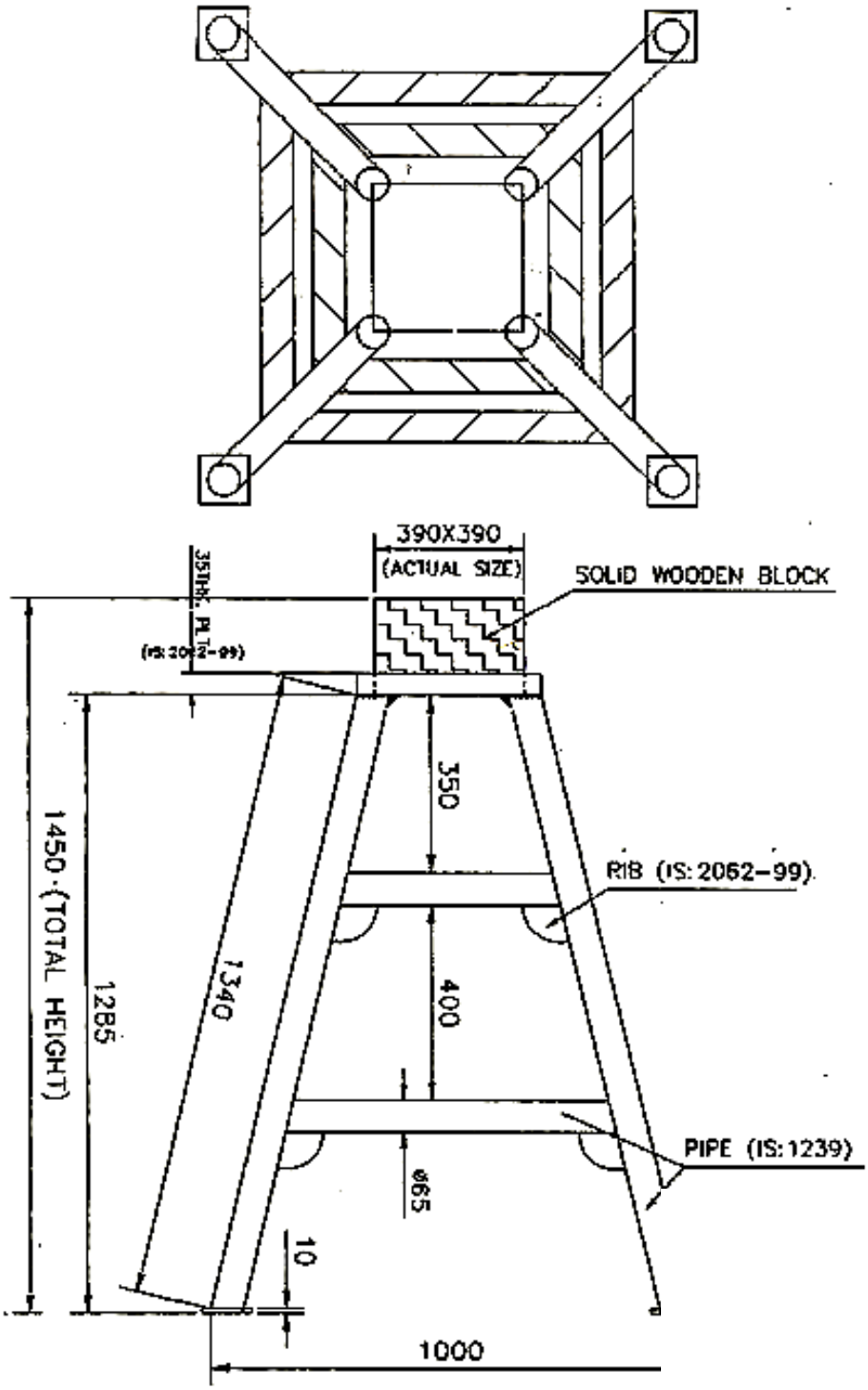


Figure: 2.4 Trestle for LHB Coach

TRESTLE FOR LHB COACH

JIG & TOOL DRG. OFFICE
29/04/04 DATE
For CWM/PL

2.9.5 Height of Centre Buffer Coupler

i) Height of CBC of a coach under its tare condition should be as under:-

Table 2

	Maximum height from rail level	**Minimum height from rail level**
Production units	1105 mm	1095 mm
Workshops	1105 mm	1090 mm

ii) CBC height of a coach should be measured under its tare condition from the top of the rail on a level and straight track. For this purpose, a specific portion of the track should be earmarked in each carriage repair workshop. Engineer (Permanent Way) should get track attended and leveled once every month and then give a certificate that nominated portion of the track has been fully attended to and is in perfect level and straight condition.

iii) The height should be measured from the rail level to center of shank.

iv) Before the height adjustment of CBCs of the coach is taken up, it should be ensured that both the couplers have been fitted properly..

v) The diameters of all the wheels measured before the assembly of the bogies must be available with the staff carrying out the height adjustment of CBCs.

2.9.5.1 Coupler Height Adjustment

Coupler height shall be adjusted by adding or removing shims from the bottom of the coupler carrier assembly when the vehicle is empty and at rest on a level track as per procedure described in chapter 5

2.9.6 Body Repairs

a) Inspection and repair of body members are done after the coach body is lifted off the bogies and placed on trestles.

b) All furnishing and other components from coach shell, which are stripped, are to be sent to the respective sections for maintenance.

c) Inspection of under frame

i) The under frame members should be thoroughly inspected for locating cracked/bent/corroded members. Corrosion is indicated by flaking of paint, flaking of metal, pitting and scale formation. Components like sole bar and trough floor which are not visible from both sides should be examined by tapping with a spiked hammer. Proper illumination will be required to carryout the check. A component will require repair/ replacement, if it has lost more than 20% of it‟s thickness.

ii) Particular attention should be paid to the more vulnerable members and locations listed below:-

- Sole bar, side wall pillar, and trough floor below lavatories in all types of coaches and the luggage compartments of all SLRs and parcel vans.

- Sole bars, side wall pillars, and pillars above lifting pads
- Sole bars and pillars behind the sliding door pockets of SLRs and parcel vans.
- Sole bars and pillars and at the door corners.
- Head stock.
- Sole bars and pillars near coach body bolster.

d) Procedure for inspection of under frame members for corrosion attention in case of vulnerable and not so-vulnerable locations should be {followed as given in RDSO technical pamphlet No. 7602 (Rev.1) ***or latest.***

i) Sole bar, body pillar at lavatory area

- Examine visually supplemented by tapping with a spiked hammer sole bars and pillars in the bays under and adjoining lavatories from below the coach after removing the accumulated dirt and cleaning the surface.
- If incidence of corrosion is noticed in the bottom half of the sole bar, the trough floor should be cut to a width of 300 mm and requisite length for examination of inside top half.
- If heavy corrosion is noticed, the side wall should be cut to a height of 500 mm. from the bottom covering sufficient length and all the exposed parts, after scraping and cleaning, should be examined to determine the extent of corrosion.

ii) Sole bar and pillars above the lifting pads

- Examine the above members in the same manner as described
- If signs of corrosion are noticed, the side wall sheet above the lifting pads should be cut to a height of 500 mm. and to a length of half meter, on either side of lifting pads. Scrape the structural members, clean and examine minutely to ascertain the extent of corrosion.

iii) Sole bar and pillars at door corners

- Examine the above locations visually. If corrosion is noticed, cut the side wall to a width of half meter from the door corner. Remove accumulated dust. Structural members should be thoroughly scraped, cleaned and examined to assess the extent of corrosion.

iv) Sole bar and body pillars at locations other than those described above

- Examine visible portion of sole from bottom of the under frame.
- Remove the accumulated dust and scrape structural members to the extent possible. If corrosion is noticed, side wall sheet in the area of corrosion should be cut to a height of 450 mm. from the bottom sufficient length for thorough examination.

v) Head stock

- Examine visually head stock, stiffening immediately behind the CBC and the junction of the sole bar at the head stock for incidence of corrosion.
- Examine visually inner head stock, outer head stock, stiffening immediately behind the CBC and the junction of the sole bar at the head stock for incidence of corrosion.

vi) Trough floor

- Examine the trough floor in the bays adjoining the lavatories and under the luggage compartments of SLRs and parcel vans from below for signs of corrosion, supplemented by tapping with a spiked hammer.
- If signs of corrosion are noticed in the above examination, the part should be thoroughly cleaned by scraping and an intensive inspection should be carried out to detect the extent of corrosion in the trough floor.

e) Corrosion repairs to under frame Members

i) Corrosion repairs should be carried out as per instructions.

It is essential to use corrosion resistant steel sheets of prescribed quality for corrosion repairs of coaches. Welding electrodes and paints should be of the prescribed quality conforming to the relevant IS/ IRS specifications.

ii) Where the corrosion noticed is of a very minor nature and has just started, there is no need to renew the parts. In those areas, the paint and the rust should be thoroughly cleaned to reach the bare metal and the surface treated with two coats of red oxide zinc chromate primer followed by the four coat system of anti-corrosive bituminous paint.

2.9.7 Roof

a) Roof repairs

i) In LHB coaches, roof should be checked for corrosion. Special attention should be paid at location where gutter moldings are welded and ventilators bolted. Corroded roof should be repaired according to the instructions.

b) Roof Ventilators repairs

i) Examine the roof ventilator for damage or corrosion or leakage. If no corrosion is observed then seal the joints and crevices with water proof sealing agent. The securing bolts should be replaced whenever a ventilator is removed. Otherwise, they should be checked for tightness. Loose and corroded bolts should be replaced.

ii) After repairs and refitting, ventilators should be tested for water leakage at their base joints at the time of roof testing.

c) Roof testing

All coaches after Shop Schedule should be tested under water spray for roof leakage before they are finally turned out from the workshop. For this purpose, a fixture designed to simulate monsoon conditions should be provided in the workshop.

2.9.8 Repairs to Door Handles

Examine the door handle for breakage, damages. If the fixing bolts are loose or missing, tighten the bolts. Replace the door handles which are found beyond repairs.

2.9.9 Repairs to Door Pivots

Examine the door pivots for corrosion, breakage or wear by cutting the bottom portion of outer panel. Cut the corroded portion of the door pillar (Z molding) and weld new piece joining the door pivot pin. If the female socket is worn or damaged beyond repairs then replace it. Replace the bush provided in the socket.

2.9.10 Repairs to CBC Support Structure

Examine the CBC support structure for corrosion, breakage, etc. If the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion is heavy, replace the corroded angle or gusset plate with new support angle.
Similarly examine the CBC support structure for corrosion, breakage, etc. If the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion is heavy, replace the corroded angle or stiffeners.

2.9.11 Water Tank Support Structure

Examine the water tank support structure for corrosion, breakage, wear, etc. If the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion, breakages are beyond repair, replace the corroded angle with new angle of suitable size as per the requirement. Replace the rubber/wooden packing if perished or damaged.

2.9.12 Repairs to Floor Channel

Examine the floor channel for corrosion, breakage, wear, etc. by cutting opening the PVC and plywood flooring where the corrosion suspected. If the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion, breakages are beyond repair, replace the corroded channels with new channel of suitable size as per the requirement.

2.9.13 P.U. Surfacer Application

P.U. surfacer/touch up on shell to be carried out as per instruction issued by RCF/Kapurthala vide document No. PLW 905 dated 09.06.2004 and M&C/PCN-100/2006.

2.10 GENERAL PRACTICE FOR WELDING

- All repairs of cracks should be carried out by gouging and welding by suitable electrodes.
- ***CAUTION:*** No electric welding on the coach should be carried out without proper earthing from near the portion being welded such that the return current has a distinct path (earth) which should not be allowed through the bogies and rails. In the absence of such earthing, the return current passes through axle roller bearings causing pitting of rollers and bearing failure in service.

- Distorted and bent parts should be heated and straightened.
- The parts used for repairs should be given proper surface treatment and applied with protective paint. Relatively thick sections such as sole bars, cross bearers, etc. should preferably be grit blasted and immediately thereafter given a protective coat of red oxide zinc chromate primer paint.

Welders' Qualification: Welders deputed to carry out welding work on coaches and coach components should be only those tested and certified as adequately skilled for welding work on coaches and coach components.

2.10.1 Repair Procedure by Welding For Cracks on Sole Bar of LHB Coach

The repair should be carried out as per ED/STD (Carriage)/RDSO: letter NO MC/LHB/Coach, dated 10.10.2007

Reason: to prevent crack developed on sole bar near yaw damper bracket.
Coach types proposed for inspection & repair are: ALL LHB type coach

Action: weld procedure shall be adopted as advised under.

Material of:

(a) Yaw damper = Cast Steel **(b)** Sole bar = Corten Steel to IRS: M-41

Welding Electrodes used for repairs: Manual metal Arc welding electrodes approved under class "D-2" as per IRS: M-28-02.

These instructions shall be implemented during Shop Schedule and special repair of LHB coaches.

Sr.No	Activity
1	To inspect condition of coach at incoming/stage inspection & final inspection
2	**Before welding:** **a)** Clean the cracked area properly to remove all dust, dirt, grease, paint etc. **b)** Use dye penetrant test (DPT) to get proper location of crack. **c)** Drill a hole of 7 -10 mm diameter at about 15 – 20 mm away from the extremities of crack. **d)** Ground/gouge the crack up to its root & the same should be confirmed by DPT test. The grinding shall be extended up to near drilled end hole. **e)** Before welding proper removal of crack must ensured. **f)** Preheat the crack location (specially the yaw damper bracket, if the crack is at the joint of the bracket of the sole bar) to about 150° C, by oxy-acetylene flame; ensure temperature by using thermal chalk. **g)** After preheating the areas to be welded are thoroughly cleaned using wire brushes; to remove any oxide or carbon block etc. present.

Sr.No	Activity
3	**During welding:** **a)** Use AC or DC welding machine. **b)** If AC welding machine is used then, it must have OCV min 70 Volt. **c)** If DC welding machine is used then, electrode is to be connected with +ve terminal of the machine. **d)** Adjust the welding current within the recommended range of electrode manufacture. **e)** Preheat electrode: 250° C for 2 hours or 350° C for 1 hour or as recommended by electrode manufacture. **f)** Suitable anti-spatter compound be applied before welding. **g)** Root run by 3.15 mm diameter electrode with higher current for proper penetration, subsequent run by 4 mm diameter electrode. **h)** Fill up the contour properly. **i)** Proper slag removal before putting subsequent run.
4	**After welding:** a) Remove all slag, spatter by using wire brush/chisel. b) Dress the final weld contour by little grinding. c) Finally check by DPT. d) If any crack is noticed, repeat the above procedure again and re-weld again. **Final inspection:** welding must be free from any crack or other harmful defect in visual & in DPT.
5	To keep records and co-ordination between shop & final inspection.
6	Procurement of suitable electrodes and other materials as above.

2.11 LIST OF TOOLS AND PLANT REQUIRED FOR SHOPS

1. EOT cranes	9. Measuring scale
2. Synchronized lifting jack 15/20Tcapacity	10. Gas cutting plants
3. Trestles for coach body	11 Multi-operator welding plants
4. Inspection torches	12. CO_2 Welding plant
5. Spiked hammers	13. Electrical angle grinders
6. Ball peen hammers	14. Pneumatic hand grinders
7. Goggles for inspection staff	15. Component painting equipment
8. Measuring tape	16. Phosphating plant

2.12 EXAMINATION AND REPAIR PRACTICE

Schedule D1, D2, D3 should be carried out in depots as per following periodicity

D-1 (D1 Schedule, Every Trip/Weekly)

D-2 (D2 Schedule, 30 days ± 3 days)

Check visually the following for any damages/defects/deficiencies, it is to be done in D1 or D2 or both:

- Destination board brackets.
- Body panels.
- End walls
- Windows walls
- Body side doors
- Condition of head stock, sole bar and other under frame members.

D-3 (D3 Schedule, 180 days± 15 days)

- In addition to Schedule D1 & D2 do the following.
- Examine trough floor and other under frames from underneath for corrosion.

The detailed items to be carried out have been covered in chapter 12 of this manual.

2.13 EXAMINATION OF TRAINS

The examination is to be carried out as per RPC-IV as amended from time to time.

2.13.1 Examination of Originating Trains

i) All trains must be examined by the mechanical train examining staff before dispatch to ensure that all coaches on the train are in fit condition and without rejectable defects. On formation of a rake and after its placement for examination, washing, cleaning and watering, the Station Master (SM) shall pass necessary memo to the Engineer (C&W). After carrying out all necessary work, the Engineer (C&W) shall communicate fitness of the train to Station Master. Normally, Railways have standard forms for the use of Station Masters and Engineers for this purpose. Railways, where such forms are not used, should also start using these forms as uniform practice for the guidance of both Engineer (C&W) and Station Master. The Station Master shall not dispatch the train unless the fitness certificate, in the prescribed form, is received from the Engineer (C&W).

ii) The level of the air pressure on the train engine and the brake van gauges and the percentage of operative cylinders should be recorded on a prescribed „Brake Power Certificate" and signatures of the driver and the guard of the train should be obtained by the Engineer (C&W) as per the procedure laid down by each Railway. A suggested standard format for the certificate is placed at Annexure „C". No train should be allowed to leave with an inoperative/defective brake cylinder on any coach after pit attention. Trains which have been attended on pitline should have 100% brake power.

2.13.2 Enroute/Terminating Examination of Passenger Trains

i) Sr.DME/DME in charge shall nominate the site for carrying out rolling in/rolling out examination after personal inspection of site. While nominating the site following should be kept in view:

a) Site shall provide unobstructed view of under gear from both sides

b) Speed of the train shall not be more than 30 KMPH.

c) It should cover the entire length of train.

d) Should have adequate space for fixing the lighting arrangement and for staff.

ii) For rolling in examination of train it has to be ensured that proper lighting arrangement is provided on both the sides of the track at nominated spots for examination of under gear parts during night. Focusing of lights shall be done by keeping a coach on the line and adjusting the angle of light to illuminate under gear and bogie. Use of fixed lights as indicated in figure 2.6 is preferable.

iii) C&W staff should take position at nominated rolling in place on both the sides of the track before the arrival of train.

iv) As the train passes the nominated point, C&W staff should watch out vigilantly for loose/hanging/broken under gear parts of the coaches, any unusual sound coming from the coaches or any other abnormality in the coaches.

v) After train comes to halt, it should be ensured that the train is protected from both the sides (with the stop board/red flag during day time and red lamp during night time) before commencing the examination of the train. It should be ensured that a suitable indication board is placed at conspicuous location visible to the driver indicating that C&W staff is at work.

vi) Temperature of the axle boxes should be measured preferably with the help of the electronic temperature measuring device.

vii) Brake release shall be checked physically. Brakes of all coaches shall first be manually released .However, in case where train locomotive has to be detached, for avoiding the rolling of rakes, it should be ensured that brakes are not released in at least 3 to 4 coaches from the locomotive end and 3 to 4 coaches from rear, these shall be released after attachment of locomotive.

viii) Other under gear parts should be examined visually to ensure that the train is safe to run further. During night the lamps/search light shall be used for illumination.

ix) Repairs if required should be carried out promptly to avoid detention to train to the extent possible.

x) Lavatories of the coaches should be properly cleaned using High pressure water jet machine provided at nominated stations during halt of the train. Any complaint from passengers should be attended promptly to the satisfaction of the passenger.

xi) After attending to any required repairs stop board/red flag should be removed.

xii) Carriage controller (CCR) should be informed about any out of course work done.

xiii) CCR shall repeat the out of course work done to the Primary Maintenance (PM) depot after corrective action.

xiv) At the train examination stations where locomotives are changed on through trains, the level of air pressure created on the locomotive and brake van gauges should be recorded on the certificate to be issued to the guard and driver on prescribed form. The inoperative/blanked cylinders, if any, should also be written in the certificate for their information. This certification should be an endorsement on the original brake power certificate; no fresh brake power certificate needs to be issued.

Approved Mandatory conditions to be fulfilled prior to introduction of Round Trip Primary Pattern of Maintenance on Coaching Trains

The following mandatory conditions should be fulfilled prior to introduction of round trip/kilometers base Primary maintenance pattern on any passenger carrying train on Indian Railways:

PRIMARY END

1. The attention during primary maintenance should be made more intensive with special emphasis on the following aspects:

   The brake gearing should be properly adjusted ensure **100% brake power.**

   Brake pad of brake disc should be changed as and when required.

   All missing passenger amenity fittings must be replaced and the rake must be turned out as „Zero-Missing-Fitting" rake.

   Intensive cleaning of coach toilets and lavatory.

   No coach should run overdue schedule.

2. Clear maintenance time of 6 hours on the pit as per train schedule. Any exception to be jointly decided by COM/CME of the Railways.

3. Provision of proper washing cum maintenance pit line facility with adequate testing equipment and high pressure water cleaning arrangement.

4. Adequate gang strength with proper supervision.

THE OTHER END

1 Whenever the lie-over is more than 2 hours at the platform or the rake is stabled in the yard, the rake should be locked and positive security should be provided.

2. Amenity and cleaning attention is ***carried out best on the washing lines*** where complete infrastructure by way of men, material and machines are available. Watering and drainage facilities are also available on these washing lines. Ideally, for cleaning and watering, the rakes should be taken to washing lines as far as possible. In the event of this being not feasible, such rakes can be returned from platform/yards. However, the minimum infrastructure to be provided at the

platforms from where trains are returned without secondary maintenance should be as under.(Ref: IRCA part IV Para E:4.1.8.6.4) and elaborated in CAMTECH"s report CAMTECH/2009/M/C/terminal Attention /1.0 of March 2009.

i) One storage room for essential safety and passenger amenity item.

ii) Road transportation facility for ferrying material from the main depot to the platform.

iii) Adequate number of mobile high pressure jet cleaning machines or high pressure water pipe line running around the platform /yard line.

iv) Washable apron on the platform lines with the covered drains to facilitate movement of maintenance staff.

v) Walkie-Talkie/mobile telephones for quick and easy communication.

vi) Standard watering hydrants.

vii) Flood light at the platform ends for rolling-in examination at night and 110 V inspection lights along the side of the track for night examination of the under gear.

3. The decision, whether such trains may be shunted for working on pit line or attended at platform itself, has to be taken carefully after weighing these factors by the mechanical and Traffic HODs on the zonal Railway on case to case basis.

4. The status of implementation of revised pattern of coaching trains should be reviewed every year in the month of June by Mechanical and Operating branches at Divisional level and any discrepancy should be removed.

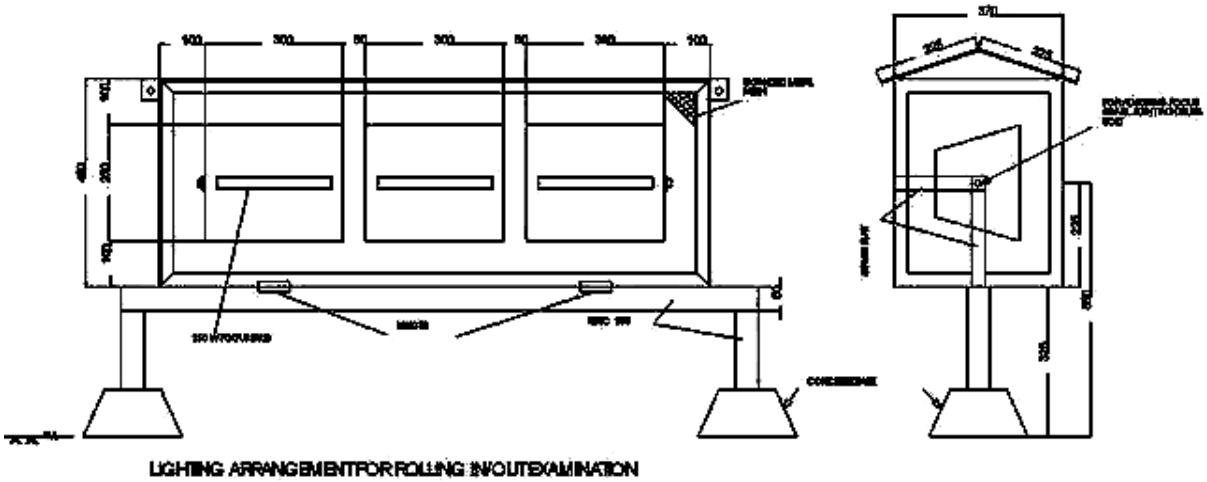


Figure: 2.6 Lighting Arrangement for Rolling in/out Examination

2.14 WASHING AND CLEANING OF COACHES

Use recommended solutions for cleaning as per RDSO specification no. M&C/PCN/101/2007 i.e. Specification for liquid cleaning composition for exterior of Railway Coaches or use cleaning agents approved by CME of the Railway.

2.14.1 Platform Cleaning And Washing

i) Wherever washable aprons are available on the platforms, the time available before the terminating trains are pulled out into the yard, should be utilised for inside sweeping and toilet cleaning.

2.14.2 External Cleaning / Washing

For the coaches with vinyl wrap instructions of RCF/ RDSO should be follow.

Coach cleaning/washing should be done by „Automatic Coach Washing Plant (ACWP).However, where these plants are not available, external cleaning/washing of coaches can be done in following manner;

i) Place the rake/coaches on the washing pit provided with equipments required for washing and cleaning. It should be ensured that the rake/coach is protected with proper board/signal for safety of the staff working on washing/cleaning job to prevent movement/disturbance in the activity. Scotch blocks with locking arrangement should protect lines and keys should be kept with Engineer (C&W) till the time rake is under maintenance. In electrified section, C&W supervisor shall in addition, obtain power block from OHE before commencing work.

ii) Remove old reservation charts/labels on the body panels. Splash water on old charts so that they are wet for easy separation. Care should be taken to avoid any damage to the paint.

iii) The cleaning solution should be spread/rubbed with nylon brush or sponge brushes and then rubbed thoroughly to clean the panels. Extra attention should be given to oily and badly stained surfaces.

iv) Destination boards may be removed and cleaned with brush/duster.

v) Clean the external surface by high pressure jet where facilities are available.

vi) All exterior panels including end panels should be hosed with water and brushed with diluted soft soap (detergent solution) the strength of the solution may be increased or decreased according to RDSO specification.

2.14.3 Cleaning of Toilet

i) Before starting cleaning of toilets ensure that all repairs in the toilets have been carried out and after cleaning no employee should enter in the toilet.

ii) Doors and walls should be cleaned with water sprayed by high pressure jet up to waist level. Apply specified solution and rub thoroughly with sponge brush/duster/nylon bristle brush.

iii) Indian style lavatory pans have to be cleaned by thorough rubbing with concentrated solution of recommended cleaning agent.

iv) Western style commode shall be cleaned as (iii) however due care should be taken that recommended solution should not fall on commode lid which may damage/spoil it.

v) The flooring should be rubbed with nylon bristles/sponge brush and cleaned with recommended cleaning agent. The drain holes should be cleaned thoroughly for easy discharge of water.

vi) The mirrors in toilet should be cleaned with light wet cloth. Recommended solution should be used for cleaning the dirty portion of glasses.

vii) After all the washing and cleaning in the toilets mentioned above, the toilets should be thoroughly cleaned with water jets and water should be flushed out. All fittings and floor should be wiped dry with a cloth.

viii) After cleaning, spray deodorant in the toilet to remove the bad odour.

ix) The facilities required should be as per CAMTECH"s report no. CAMTECH.M.Coaching Infra/1.0/Dec 2009.

2.14.4 Internal Cleaning of AC & Non AC Coaches

i) Collect the news paper from magazine bag and waste from dust bin. Sweep the whole coach with broom in sleeper coaches. Clean the floor of AC coaches with vacuum cleaner.

ii) Remove dust from floor, berths/seat, magazine nylon wire mesh bag fitted on panels and fan guards with duster. Use of vacuum cleaner is excellent in such areas.

iii) Also remove dust/dirt from under the berths, window sill, sliding door, railing corner and all corner & crevices of coach interior with vacuum cleaner if provided.

iv) Ceiling panels, wall panels, cushion berths, fittings, table top, etc. should be cleaned with duster and stain marks on these should be removed by use of recommended soft detergent.

v) Aluminum frames, strips, and other metal fittings, etc. should be cleaned with recommended cleaning agent.

vi) FRP window frames, louvers, etc. should be cleaned with recommended solution and rubbed out by nylon brush or sponge /duster to remove stain marks.

vii) Alarm chain handle and its holding bracket should be washed and cleaned.

viii) The coach flooring should be rubbed with hard coir brush and PVC flooring should be rubbed with nylon bristles/sponge brush and cleaned with recommended cleaning agent.

ix) The amenity fittings and toilet fittings such as coat hanger, stools, arm rest, foot rest, towel hanger, etc. should be cleaned with duster. Stains on these items should be removed with recommended detergent solution.

x) The compartment carpet should be cleaned with vacuum cleaner. Every month, the carpet should be cleaned thoroughly by taking it out from compartment and if

necessary they should be dry cleaned in every three to four months. Before re-laying the carpet, the compartment floor should be thoroughly cleaned.

xi) Spray recommended air freshener in the coach. No employee should be allowed to enter the coach for any purpose/work after complete cleaning

xii) Curtains in the AC Coaches and Tourist Cars should be removed for periodical washing and cleaning. Faded and damaged curtains should be replaced on condition basis.

xiii) Precaution should be taken to prevent nuisance of cockroaches and rodents in AC coaches and pantry car

xiv) No repair works should generally be left to be carried out after washing and cleaning of the coach.

xv) Pest and rodent control should be done as per extant instructions issued by the Railway Board from time to time.

xvi) The facilities required should be as per CAMTECH‟s report no. CAMTECH.M.Coaching Infra/1.0/Dec 2009

2.14.5 Internal Cleaning of GS, Generator Car/SLR

(i) Cleaning of GS, guard and passenger compartments of SLR should be done as mentioned under para 2.14 d above wherever applicable.

(ii) If necessary clean the wooden seat and their frames with recommended detergent solution and water.

(iii) Interior surfaces of parcel and luggage vans should be cleaned with recommended detergent and water.

2.15 MAINTENANCE PRACTICES IN OPEN LINE DEPOTS

2.15.1 Nomination of a Depot

i) All passenger coaching vehicles (PCVs), other coaching vehicles (OCVs), owned by individual railways should be allotted a base depot for primary maintenance and a base workshops for periodical overhaul and special repairs by the Chief Mechanical Engineer/Chief Operation Manager of the Railway.

ii) The base depot to which the coaches are allotted will be responsible for their maintenance. This depot will also be responsible for the secondary maintenance of the coaches as prescribed by the Railway.

iii) If a coaching stock allotted to a particular depot, finds its way to another depot, it should be despatched to the allotted depot for proper service.

iv) Due to exigencies of service a coach of another depot can be retained with the sanction of the Chief Mechanical Engineer (CME). It should, however, be subjected to necessary examination and repairs including maintenance schedules in the manner as it belonged to the depot.

v) No overdue periodical overhaul (POH) coaches of other railway should be allowed in service but should be booked to the owning railway for POH.

2.15.2 Special Repairs

i) The special repairs (Non-POH repairs) by workshops are those repairs, which can not be done in the sick-line with their existing facilities or are specifically prohibited to be carried out on the divisions.

ii) Special repair coaches should be sent to the base workshops only after obtaining the permission of the Chief Mechanical Engineer and according to the calling in program of the workshop.

iii) For requesting permission for non-POH repairs, the supervisor in charge of the depot should prepare a complete list of damages and deficiencies and forward it to Divisional Mechanical Engineer for getting permission of the Chief Mechanical Engineer to book the coach to the shop for non-POH repairs. A copy of the list of damages and deficiencies should simultaneously be sent to the workshop concerned for planning it in their calling-in programme.

2.15.3 Formation of Block Rakes

i) For the purpose of maintaining the coaches and the rakes in good condition and to avoid public complaints, the Chief Mechanical Engineer, in consultation with the Chief Operations Manager of the Railway, shall form Block Rakes for each of the long distance trains and the inter-railway trains; and also nominate spare block rake coaches of adequate number for these block rakes to replace sick block rake coaches.

ii) The station staff shall ensure that no non-block coach is attached in any Block Rake except with the express permission of the Divisional Mechanical Engineer, who will grant such permission only in emergency and that too for a specified trip only.

2.15.4 Destination Boards

Coaches on originating trains should be provided with approved destination boards. LED based destination Boards should be provided as per extant instructions by Railway Board and RDSO‟s specifications RDSO/2009/CG-01 Rev-01 of Feb‟10 or latest.

2.15.5 Fire Extinguishers

Fire Extinguishers (DCP) should be provided on all originating trains according to the number prescribed by the Railways for air-conditioned coaches, brake vans, postal vans, dining cars, etc. These fire extinguishers should be checked every three months and completely refilled after one year. These extinguishers should not be overdue testing / refilling. In case they are used or damaged en route, the report of the same should be obtained from the guard, and replaced.

2.15.6 Brake Van Equipment

Similarly, other brake van equipment, which mechanical train examining staff is responsible to supply, should be provided according to the instructions of each Railway. As per RDSO's letter, racks have to be provided in the SLRS/Generator Car for provision of portable control telephones, portable train lighting equipments, portable fire extinguisher, wooden wedges/skids and stretcher.

2.15.7 Watering and Cleaning of Rakes

i) Mechanical department of each railway will nominate the watering and the cleaning stations on the railway.

ii) All water tanks should be filled on a washing line so that no watering is necessary on a platform at the originating station. Arrangements should, however, be available at each of the platforms for filling the tanks in emergencies.

iii) Adequate staff and time should be provided at intermediate stations to enable complete replenishment of all the water tanks of the train at each of the nominated watering stations of the railway. The facilities required for enroute coach watering should be as per CAMTECH‟s design.

iv) In case of ground level side filling watering arrangements, it should be ensured that water hose pipes are not dragged or left over on the platform aprons, but are hung properly on the poles to prevent contamination of water.

v) Adequate staff and time should be provided to clean the compartment and the bathrooms/ lavatories as prescribed at nominated cleaning stations of the railway. Portable pressure jet cleaning equipment should be used for efficient cleaning of toilets.

vi) Deployment of C&W staff on Rajdhani/Shatabdi Express/Rajdhani type nominated trains/Other super fast and Mail/Express trains should be as per Railway Board's letter no. 99/TG.V//12/2 dated 13.9.99. The `Safaiwalas' should wear identification armbands while on duty. A suitable cleaning kit consisting of requisite cleaning agents, brushes, mops, etc. should be standardized by the Railway and provided to them.

vii) On Board cleaning of trains should be done as per extant instructions of Railway Board for on „Board House Keeping Services‟ (OBHS).

2.15.8 Deficiency Rolling Stock (DRS) for Coaching Stock

i) Railway should devise system for detecting deficiencies. Reports of deficiencies/defect sin Rolling Stock (DRS) reports in the proforma given in Annexure D & D1 should be prepared for each mail/express/passenger originating train in duplicate by the Engineer (C&W)/ Engineer (Electrical) and should be signed jointly with the RPF representatives. Reports for mechanical deficiencies should be prepared on Performa I (the fittings mentioned in these Performa are selective and not exhaustive and may be altered by each Railway on the basis of the items most prone to theft on their system). This should be done soon after the maintenance of the rake is complete in the sick/ washing lines. In case the train starts from the platform itself, these reports should be prepared by the train duty Engineer (C&W)/ Engineer (Electrical). The originating station must keep copy of the report. It should be preferable if one booklet is maintained for each service so that the carbon copy is sent with train guard, retaining the original for record.

ii) After the coaches have been jointly checked, and DRS reports have been made, the coaches should be padlocked/ key locked and the key and report should be sent to the platform Engineer (C&W).

iii) **Coaches with attendants**

For the coaches, which have nominated attendants, the DRS card will be given to him. Deficiencies will be noted down by the attendant and advised to Engineer (C&W) and Engineer (Electrical) at the coaching depot after end of the journey, will have to keep a register noting down the deficiencies and the date of advice and the date of recoupment.

iv) **Trains which are escorted by Engineer (C&W) & Engineer (Elect.)**

For trains where an escorting C&W staff is provided on the train, he shall carry DRS card for coaches other than para iii) above and get them filled up at the secondary maintenance depot by the Mechanical/Electrical staff and get the rake examined by RPF personnel in case of any deficiency.

v) **Trains/Coaches not covered in para iii) & iv)**

a) For other trains/coaches not covered in para iii) & iv), the DRS Reports should be handed over to the train guard and his signature obtained on the office copy. The guard will be responsible for safe carriage of the Report up to the destination. At the destination station, the outgoing guard must ensure that the reports are handed over to the Mechanical/Electrical staff immediately on arrival of the train.

b) On arrival of the train at the destination station, the Engineer (C&W) staff and Engineer (Electrical) staff shall check the rakes jointly with a representative of RPF and comparison may be made with original report. If original report is not received, the general inspection should be recorded on DRS Cards as done at originating stations. New DRS Cards showing deficiencies/ defects of each vehicle will be prepared and sent to originating station along with the rake. In case vandalism is suspected, suitable remarks should also be given. The Engineer (C&W) staff, Engineer (Electrical) staff and RPF staff should sign the report. On receipt of the report by the originating station, a comparison will be made and statement prepared of deficiencies that occurred enroute.

vi) The Supervisors at the destination station, viz., Engineer (C&W)/ Engineer (Electrical) shall report the thefts on the form already prescribed by RPF, to the RPF/GRP as quickly after arrival of the train as possible as and not later than 24 hours after the arrival of each rake. If the GRP refuses to accept such reports at the arrival station of train from the Mech. /Elec. Supervisors, it shall be incumbent on the RPF in-charge at the arrival station of the train to get cases registered with GRP and take further action as deemed fit to get the thefts traced/ reduced. If such reports are to be made to any other RPF post, this shall also be done by the RPF in-charge of the train arriving station.

vii) The Supervisors of the originating station should compare these DRS Reports with the original DRS Reports and prepare a summary of the deficiencies/ thefts occurring in the up and down trips separately.

viii) A train wise summary of the deficiencies/ defects shall be prepared and forwarded to the DME/DEE with a copy to Security Commissioner, RPF, of the division. The cost of the fittings should also be shown in the summary, price being taken from IRCA Rules Part IV. For items not covered in these, stores cost should be given.

ix) In the first week of every month, supervisors in charge of Mechanical, Electrical and Officer- in charge of RPF Posts/Outposts should hold a joint meeting to identify the areas where the deficiencies/ thefts are occurring and analyses the items more prone to breakage/losses/thefts. The officials should take remedial measures as possible at their level. A monthly statement of thefts, giving their cost and analysis should be prepared by RPF but jointly signed by Engineer(C&W), Engineer (TL) with the copy each sent to DME, DEE and Security Commissioner, RPF.

x) The Divisional Officers, viz. Sr. DME, Sr. DEE & SC must meet every three months to carry out similar analysis and decide upon preventive steps to be taken in each area. They should submit similar joint report to their Headquarters Officers concerned, viz., CME, CEE and CSC.

xi) The CME, CEE and CSC should furnish every six months a report to the Director/ Mechanical Engineering (Coaching), the Director/ Electrical Engineering (Coaching) and DG/RPF in the Railway Board, indicating the extent of theft of C&W and electrical fittings on their system and the remedial measures taken by them bringing out any help in any area required from the Ministry of Railways.

2.15.9 Reporting of Thefts

i) All damages/deficiencies which may apparently be due to mischief or theft during service should be reported to the RPF/GRP and the Divisional Mechanical Engineer according to the procedure laid down in Railway Board's letter No.73M(c) /165/4 dt.4.7.77

2.15.10 Coach Maintenance History Card

i) Every coaching depot shall have computers for maintaining the coach maintenance history in a software programmed which should be compatible with the programme of the coaching workshop.

ii) The "Coach Maintenance History Card" (MHC) for each of its coaches. The card will contain records of maintenance schedules including POH and special repairs in shops. It will also show the history of the coach from the time the coach is placed in service till its condemnation and will give details of all major repairs like wheel changing, bogie changing, etc.

iii) The complete history book of each coach, consisting of maintenance history cards, date card, trial card, etc. will, however, be maintained by the base workshops. When a coach is sent for Shop Schedule or special repairs, a copy of its maintenance history card should be sent by its base depot to the workshops for record in its complete history book.

iv) The workshops should send a new maintenance history card (MHC) giving the condition of the coach, the list of important fittings and furniture in case of Air Conditioned coaches, dining cars, etc., defects and deficiencies of the fittings, if any, to the base depot when a coach is turned out of workshops after POH or special repairs. Any special instructions regarding the coach for its base depot should also be maintained in the card. If modifications are carried out, they should be indicated in the card under its appropriate column. Similarly, if trial fittings/ components are fitted or materials are on trial on the coach, the details of the fittings/ components or the materials, the authority for conducting such a trial, the purpose of the trial, the nature and the frequency of the observations to be made, the type of interim/final reports required to be submitted, the name and the address of the authority to whom it is to be submitted and any other instruction in detail should be maintained in a "Trial Card" which should be sent by the workshops to the base depot for compliance of the instructions. The base depot, on receipt of the coach from the shop, will check the fittings/ articles in the coach with the list sent by the workshops and note all the instructions for compliance. It will also make examinations and observations as prescribed in respect of trial fittings, components or materials and submit the trial reports to the appropriate authority as prescribed in the Trial Card received with the coach.

v) The base workshops will also carry out a detailed examination when a new coach is received, register the coach, open its history book, make a list of all defects and deficiencies and then, in consultation with the CME's office, will allot a rake number and its base depot. The same should be stenciled on the coach end. If it is fit in all respects, it will be sent to the base depot for service. Also, the workshop it will prepare a warranty card as per Performa given in Annexure „E‟ and will forward it to the base depot with detailed instructions for preferring claims from the manufacturers through Divisional Mechanical Engineer.

2.15.11 Warranty Claim for Defective/Failed Items

There are some items for which it is mandatory for the manufacturers to give warranty claim if the item fails or becomes defective during the warranty period as specified in the specification/drawings /purchase order.

2.16 MAINTENANCE SCHEDULES TO BE FOLLOWED IN COACHING DEPOTS

a To maintain coaching stock in good condition, the following maintenance schedules are prescribed to be carried out in carriage depots on divisions where rake has been based for primary maintenance.

(i) Trip Maintenance Schedule i.e. **D1 Schedule- Every Trip/Weekly**

(ii) Monthly Maintenance Schedule i.e. **D2 Schedule- 30 days ± 3 days**

(iii) Six Monthly Maintenance Schedule i.e.**D3 Schedule 180 days ± 15 days**

A detailed table of maintenance activities to be carried out during schedules is enclosed as Appendix.

b Maintenance schedules are required to be carried out by the base depots to which coaches are allotted. In emergency, when due to any reason coaches cannot reach their base depots and maintenance schedules become due, D1 & D2 schedules can

be undertaken by the carriage depots where the coaches are available. „D3" schedule should be done at base depot only.

c Each coach should be stenciled at a suitable place on its end panel, the code name of the base depot and a schedule chart. The date and station code of the depot where a particular schedule is carried out should be stenciled at the appropriate place in the schedule chart immediately when the schedule is completed.

2.17 SCHEDULE EXAMINATION

Schedule `D1' is required to be given every trip/weekly at the nominated primary maintenance depot within the normal primary maintenance time on a washing/pit line in a rake. A coach need not be detached from the rake for Schedule `D1' examination unless it requires such repairs which cannot be attended in pit line or within the prescribed maintenance time on the pit line.

2.17.1 Detachment a Coach

A coach is detached from the rake due to several reasons such as:

i) For shop schedules.

ii) For maintenance of major break–down/ mal-functioning of any sub assembly etc. the decision whether the coach is to be detached from the formation, for attending to maintenance/replacement of major subassembly is dependent on maintenance requirements, operational convenience, time availability etc. The decision is taken by the Engineer (C&W). Coach failure report as per Annexure „F" should be made. For failure components/assemblies during warranty, action to be taken for warranty claims.

Procedure

The activities performed to detach a coach with Air Brake system are as follows:

i) Safety precautions shall be taken to prevent injury while detaching/attaching a coach.

ii) Remove the clamps on the cut-off angle cocks. Close the cut-off angle cock of both feed pipe and brake pipe on both sides of the coach that has to be detached.

iii) Close the cut-off angle cocks of the feed and brake pipe of adjacent coaches. This is to ensure that the air pressure locked up in the air hose coupling gets vented to atmosphere through the vent hole of the cut-off angle cock.

iv) Observe above mentioned safety measures to close all the four cut-off angle cocks on either side of the coach to be detached so that while opening air hose coupling, it may not cause injury due to air pressure inside.

v) Release the brake of the coach to be detached by pulling the manual release lever of the distributor valve.

vi) Open the Feed Pipe and Brake Pipe hose coupling from both sides of the coach.

vii) Uncouple the coach by operating uncoupling handle.

Observe all other safety measures as prescribed.

2.18 AIR BRAKE RAKE TESTING PROCEDURE

For Air Brake testing procedure please refer to chapter 4 of 'Air Brake System' of this manual.

2.19 SPECIAL SCHEDULE

For high speed trains and some special coaches like Power Vans, etc., special maintenance schedules by the individual railways may be followed.

2.19.1 Procedure for Sending the Coaches to Shops for Shop Schedule

The following procedure may be followed in regard to movement of coaching stock for repair to shops: –

(a) Security Department shall arrange to escort all coaches booked to shops when booked by coaching specials or in lots of 3 coaches or more on receipt of memo.

(b) All coaches booked to shops for Shop Schedule will be booked by passenger/parcel/Coaching special.

c) Before any carriage is allowed to proceed to workshops a joint check should be carried out by the representatives of the Mechanical, Electrical and Security Branches on the basis of which a deficiency list should be prepared at the rake/coach maintaining station under joint signature of the three representatives in five legible copies with proper reference, number and date out of which one copy should be pasted in side the compartment on one of the end wall. Two copies of the deficiency list will remain in the personal custody of the RPF sainik accompanying the rolling stock to the workshop (In case of unescorted coach, deficiency list will be sent by post to CWM concerned and one copy will be sent to OC/RPF).the remaining two copies will be retained by the Engineer (C&W) / Engineer (Elect.) supervisor of the base station. Upper class coaches must be pad locked/locked with carriage key and also sealed after the joint check at the starting station by the booking Engineer (C&W).

d) Once a Joint check has been carried out and the deficiency list drawn out no removal of fitting from the stock at the starting depot should be entertained.

e) Coaches escorted by the RPF staff will continue to be under watch of the Security Force (RPF) until coaches are taken over by the shops. On arrival of carriage at the Workshops, a careful check is made out jointly by the representatives of the Mechanical & Electrical Departments in presence of RPF staff in four copies. In case of any additional deficiency being noticed, a list of such additional deficiencies be made out in four copies jointly by all the three staff.

(f) One copy each of the deficiency list prepared by the representatives of workshop duly signed by RPF be sent to the Engineer (C&W) /Elec. Supervisor of base station and one copy be given to RPF for submission of the same to the OC/RPF of the base station and one copy is to be kept on shop record. On receipt of the additional deficiency list, OC/RPF of the base station will arrange to fix

responsibility for the additional deficiencies and take suitable action including sending a copy of his report to Engineer (C&W) / Engineer (Elect.) Supervisor concerned. On receipt of the report from OC/RPF, Engineer (C&W) /Elec. Supervisor will submit a report to the controlling Divisional Officer enclosing copies of the original as well as the additional deficiencies to enable the Divisional Officer to initiate action for the write-off of the cost of such materials. While granting write off or forwarding the case to Headquarters for arranging the write off due remarks should be given for the reasons of the deficiencies and the action taken. A certified true copy of the joint check mentioned above should accompany the losses due to theft and pilferage.

A copy of the write-off memo should be submitted to Budget section of the divisional Headquarters office for exhibition in Appropriation Accounts.

(g) Generally coaches should be sent in lots of three duly escorted. In exceptional cases coaching stock coming to Workshop by passenger/parcel trains unescorted by RPF sainik, the deficiency list prepared jointly at the originating station should again be checked at the workshop in presence of RPF representative and the difference of the two checking should be taken as theft. On receipt of unescorted coach in the Shop, the deficiency list in five copies in presence of representatives of RPF, Mechanical and Electrical Dept. will be prepared jointly. One copy of the deficiency list will be retained as office copy, 2 copies will be given to OC/RPF of the shop station and one copy each will be sent to Engineer (C&W) / Engineer (Elect.) Supervisor of base station. Out of two copies of deficiency list received by the RPF representative at the workshop, one copy be sent to OC/RPF base station for necessary action by the security Department.

(h) The workshop should have a proper organization to check these coaches immediately on arrival.

ANNEXURE 2.1

PERT for shop schedules of LHB COACHES

Name of Activity	Brief of Activity	Shop	Details of activities	No. of days	Type of Activity
A	Pre inspection and stripping	CR (AC)	Stripping of partition and ceiling of pantry , pantry door, etc.	1 Day	Direct Act.
B	Pre inspection and stripping	AC (Electrical)	Pre inspection of deficiency,	1 Day	Parallel to Act. A
C	--do--	--do--	Testing and analyzing of coach defects, panel equipment, AC plant, water Pump, transformer etc.	1 Day	Direct. Act.
			Stripping of all equipments.	1 Day	Direct. Act.
D	Lifting and lowering	CR (Lifting)	Before lifting of the coach dismantling of bogie components under pit under such as traction lever ,anti roll bar control arm etc.	1 Day	Direct. Act.
			Lifting of the coach and washing of bogie	1 Day	Direct. Act.
			Repairing of bogie, control arm fitting on wheel and lowering of coach.	1 Day	Direct. Act.
			Repairing of Air brake components on panel, fitting of silent blocks, fitting of bogie components under pit and air brake testing.	1 Day	Direct. Act.
			CBC and WSP system repair	1 Day	Direct. Act.

PERT for shop schedules of LHB COACHES					
E	Intermediate tank cleaning And CDTS testing	Plumbing	Cleaning of the CDTS intermediate water Tank before lifting of coach on stripping line	1 Day	Parallel to Act.D
			Washing of intermediate water tank, bench testing of CDTS panel, valves etc. in CR/L shop.	1 Day	
			Fitting of intermediate water Tank in the coach in lifting shop.	1 Day	
F	Body repair and furnishing work	CR(AC)	Stripping of lavatory ceiling, repair of lavatory door, repairing of vestibule door, cushion stripping ,repair of reclining gear, foot rest, snack table stripping of the fittings Viz. Bottle holder, mirror etc.	4 Day	Direct. Act.
G	Fitment and testing of electrical equipments	AC (Electrical)	Loading of all equipments except RMPU	2 Day	Direct. Act.
			RMPU loading, loading of pantry equipment etc.	2Day	Direct. Act.
			Complete testing, fault diagnosis and their remedy.	2 Day	Direct. Act.
H	Other body repair works	CR(AC)	Stripping and Fitting of window glasses, Flooring work etc.	1 Day	Parallel to Act.G
			Repair and fitment of saloon sliding door, roller blinds etc.	1 Day	
			Repair and fitment of entrance door ,electrical panel door etc.	1 Day	
			Fitting of pantry partition, ceiling, pantry doors, lavatory ceiling, other fittings etc.	1 Day	
I	Exterior Painting	Paint	Washing with suitable detergent	1 Day	Direct Act.
			Application of Putty	1 Day	Direct Act.
			Rubbing Down Putty and application of Surfacer	1 Day	Direct Act.
			Window Masking, Roof Painting, End painting and painting of side Panels leaving down side area.	1 Day	Direct Act.
			Masking of upper area and down side painting	1 Day	Direct Act.

			Removal of masks, touch up, lettering, cleaning and other works.	1 Day	Direct Act.
J	Interior Painting	Paint	Internal painting	2 Days	Parallel to act.I
K	Fitting work	Fitting	Body panel repair, Stripped body repair, Repair of inner members like partition frames, Chair angles and seat supports etc.	2 Day	Parallel to Act.F
L-1	Trimming work	Trimming	Stripping of curtains on stripping line	1 Day	Parallel to Act.A
L-2			Stripping of seats in Carriage AC shop	1 Day	Parallel to Act.F
L-3			Fitting of seats and curtains in the coach	1 Day	Parallel to Act.G
L-4			Cleaning of the seats and other activities	1 Day	Parallel to Act.N
M	Water tank testing	Plumbing	Testing of under slung/over head water tank in CR Body/CR AC section.	1 Day	Parallel to Act.G
			Repair and testing of water tank in Plumbing shop.	1 Day	
			Fitting of water tank in the coach.	1 Day	
			Fitting of CDTS panel in coach in CR Body/CR AC shop	1 Day	
N	Final inspection	CR(AC)	Final inspection and despatch	1 Day	Direct. Act.
O	Air brake testing.	R(Lifting)	Final Air brake testing	1 Day	Parallel to Act.N

Total days of Direct Activities **25 Days**

ANNEXURE '2.2'

Hkkjrh; jsy
Indian Railways
cszd ikoj izek.k i=
BRAKE POWER CERTIFICATE

1. Date
fnukad

2. Station/Railways
स्टेशन/ रेल्वे

3. Train No.
Vsu ua-

4. Load
ykM

5. Engine No.
batu ua-

6. Attached at
xkMh ij yxus dk le;

7. Air Pressure ready

,;j izशर
rS;kj gksus dk le;

8. Air Pressure. on Departure
एयर प्रैशर
pyrs le;

In engine
batu esa

In Brake Van
czsdoku esa

Air Pressure एयर प्रैशर		
FP	**BP**	

9. Pressure of Brake Power
सुचलित ब्रेक पावर का प्रेशर

Air Brake Train 100%
,;j czsd Vsu

9. A.i) Total No. of brake/Cylinders
czsd@flysMjksa dh dqy la-
No. of operative Brake Cylinders
vkijsfVo czsd flysMj dh la-

10. Individual numbers of two coaches next to the Engine and at rear end and 4 middle coaches.
एयर प्रैशर Vsuksa esa batu@ czsdoku esa yxs nks dksp ds ua- buds vfrfjDr chp ds pkj dkspksa ds u- Hkh vafdr djsA

Engine end
batu ls

Rear end
fiNys fljs

Middle
e/;

"THIS CERTIFICATE IS VALID PROVIDED THE RAKE INTEGRITY IS NOT BROKEN OR CHANGED, OR THE TRAIN ENGINE IS NOT CHANGED. IF RAKE INTEGRITY IS BROKEN OR THE TRAIN ENGINE IS CHANGED, THIS CERTIFICATE SHOULD BE REVALIDATED BY ENGINEER (C&W) THROUGH ENDORSEMENT IN THE COLUMN PROVIDED ON REVERSE AFTER ENSURING BRAKE CONTINUITY, PROVIDED THE COACH (ES) BEING ATTACHED, IF ANY, HAVE BEEN MAINTAINED AS PER EXTANT INSTRUCTIONS".

"यदि रेक खंडित न हुई हो या रैक फोर्मेशन में कोई बदलाव न किया गया हो अथवा गाडी का इंजन बदली न कि;k x;k gks rks यह प्रमाण पत्र वैध होगा।भयदि रेक खंडित हुआ है या रैक फोर्मेशन में कोई भी बदलाव किया गया है अथवा गाडी का इंजन बदली किया गया हो तो लगाये गये यान ;यानोंद्ध जो लागू निर्देशों के आघार पर अनुरक्षण किये गये हों- lfgr cszd fujUrjrk lुनिश्चित कर अभियंता ;कै- ,o oxu) }kjk fiNys vkj fy[k dkye e vfdr djd cszd izek.k i= dh iu% o/krk izekf.kr dh tk;xhA

Driver's name & signature
Mªkboj dk uke o gLrk{kj

Guard's name & signature
xkMZ dk uke o gLrk{kj

Engineer (C&W)
vfHk;ark ¼dS ,oa oS-½

(Space for enroute endorsement & Driver's remarks on the reverse)
ड्राइवर की शिकायतें पीछे पन्ने पर

II. Driver remarks & enroute endorsements by Engineer (C&W)
jkLr e ykdk ik;yVk }kjk dh x;h fVli.kh d vuqlkj vfHk;qrk ¼d ,o o½ }kjk dh x;h iqf"V lgh djukA

Station/Rly. where examined स्टेशन / jyo tgk ijh{k.k fd;k x;k gk	**Engine No** bqtu u-	**No. of vehicles without brake power**			**Percentage of brake power** cd ikoj dk çतिशत	**Signature of Engineer** xkMh ijh{kd d gLrk{kj
		DV Mh 0gh vkbl kyV	**S.A.B** ,l ,fr ch [kjkc	**Brake rigging** [kjkc cd fjfxx		

IMPORTANT

1. The incoming Driver shall handover the certificate to relieving driver. If he is leaving the train without relief, it shall be deposited with the authority nominated to receive it, who will give it to the outgoing Driver.

budfex Mkboj dk pkfg, fd og viu iek.k lk= vkmV xkbx Mkboj dk lkiai n vkj ;fn og fcuk fjyhoj d Vu NkM jgk g rk og viu iek.k lk= ml vf/kdr 0;fDr d ikl tek dj tk fjyhfox Mkboj dk lkiiA

2. The outgoing Driver & Guard will satisfy themselves from the coach nos. given in item 10 that the certificate pertains to their train.

tku oky Mkboj rFkk xkM] dekd 10 e fy[k g, dkp u- l viuh xkMh d dkp u- l feyk,iA

3. It is responsibility of the Driver of train to satisfy himself that the brake power certificate is proper and valid, before working the train .

यह ट्रेन ड्राइवर की जिम्मेदारी है कि वह ट्रेन स्टार्ट करने से पहले सुनिश्चित करे कि ब्रेक पावर lfVfQdV ijh rjg l lgh ,o o| gA

ANNEXURE '2.3'

---------- RAILWAY

DRS CARD IN THE TRAIN SHOWING CONDITION OF MECHANICAL EQUIPMENTS

Rake No. … Train No. ……. Date: …… Card No. ……

Coach NO. Type & Owning Rly.	FRP Panels	Arm rest	Mirrors	Upholstery	Upper Berth Fenders	Snack Table	Magazine Pocket	Folding Table	Bottle Holder	Coat Hooks	Ladder or foot steps	Remarks	Check enroute
1	2	3	4	5	6	7	8	9	10	11	12	13	14

Signature of inspecting staff	At Departure	On Arrival
	Engineer (C&W)	Engineer (C&W)
	RPF	RPF
	Guard	

Checking official will enter date, time and place after signature

ANNEXURE '2.3'

---------- RAILWAY

DRS CARD IN THE TRAIN SHOWING CONDITION OF MECHANICAL EQUIPMENTS

Rake No. …… Train No. ……. Date: ……. Card No. ……

Coach NO. Type & Owning Rly.	ICV Pull Box	Emergency Window	Locks of ceiling panels	Curtains (Partition & Window)	PVC - Inside the compartment	PVC - Aisle area	Luggage Racks, Luggage Ropes	All mandatory instructions stickers	Remarks	Check enroute
1	2	3	4	5	6	7	8	9	10	11

Signature of inspecting staff	At Departure	On Arrival
	Engineer (C&W)	Engineer (C&W)
	RPF	RPF
	Guard	

Checking official will enter date, time and place after signature

ANNEXURE '2.4'

WARRANTY CARD

PROFORMA FOR REPORTING DEFECTS ON THE NEWLY BUILT COACHES DURING THE WARRANTY PERIOD

1. Coach No.
2. Code transportation …….Mechanical code
3. Owning Railways
4. Name of manufacturer
5. Date of manufacture
6. Date of commission
7. Due date of warranty inspection
8. Date of inspection(by the depot)
9. Defects attributable to the manufacturers

Remark ……. (cost will be advised by the Railway board)

Report No. ……

Engineer (C&W)
(Rubber stamp of the depot)

ANNEXURE '2.5'

---------- Railway

Carriage Depot …….. (station)

COACH FAILURE REPORT

Train Details:

Date

Station

Originating Stn.

Prim. Maint. Depot

Train No.
Division
Last Exam. Stn
Sec. Maint. Depot.

Coach Details:

Coach Number

Coach type code

Last POH Date & Shop

Owning Railway & Base Depot
Coach Make: ICF/RCF
Return Date

Failure Particulars:

Cause of Failure (Detachment)

Defect found (on examination)

Remarks:

File No.

DRM(M)'s Office,
---- Railway
---- (Station)
Date:---------

Copy forwarded to:

CME, (owning) Railway
CME, (reporting) Railway
Sr. DME, (C&W), Division Railway (of primary maint. depot)
Sr. DME, (C&W), Division Railway (of Secondary maint. depot)
CWM, Railway and Workshop (of last POH)

(Signature)
(Name and Designation)

ANNEXURE '2.6'

File No.

CWM's Office
Carriage Workshop
_____Railway
Tele/Fax. no.,e.mail no.
Date:

To,
M/s

Sub: Warranty claim for failed /defective item (name) _____

1	Reporting workshop & Railway	
2	a) Coach no. & type	
	b) POH date	
	c) Return date	
3	a) Manufacturer's name	
	b) Date of Manufacture	
	c) No. given by Manufacturer	
4	Date of supply to workshop	
5	a) P.O. No.	
	b) Name of Inspecting agency	
6	a) Date of first fitment	
	b) Date of failure	
7	Type of service to which coach is generally attached	
8	Defects found/ cause of failures	
9	Other observations and remarks i) ii) iii) iv) v)	

Inspecting Officer
For CWM

Copy to:-

1. CME/ Rly. for kind information
2. COS/ Rly. for kind information
3. ED/Carriage/ RDSO Manak nagar Lucknow - 226011
4. CME/ ICF Perambur, Chennai/ RCF Kapurthala & BEML Bangalore
5. COS/ ICF Perambur, Chennai/ RCF Kapurthala & BEML Bangalore
6. Dy COS/Workshop for proper storage, delivery and receipt
7. Inspecting agency

ANNEXURE '2.7'

File No.

CDO's/ DRM's Office
_____ Division
_____Railway
Tele/Fax. no.
Date:

To,
M/s

Sub: Warranty claim for failed /defective item (*name of item)*

1	Reporting Division/Depot & Railway	
2	a) Coach no. & type	
	b) POH date	
	c) Return date	
3	a) Manufacturer's name	
	b) Date of Manufacture	
	c) No. given by Manufacturer	
4	Date of supply to workshop	
5	a) P.O. No. (if available)	
	b) Name of Inspecting agency (if available)	
6	a) Date of first fitment	
	b) Date of failure	
7	Type of service to which coach is generally attached	
8	Defects found/ cause of failures	
9	Other observations and remarks i) ii) iii) iv) v)	

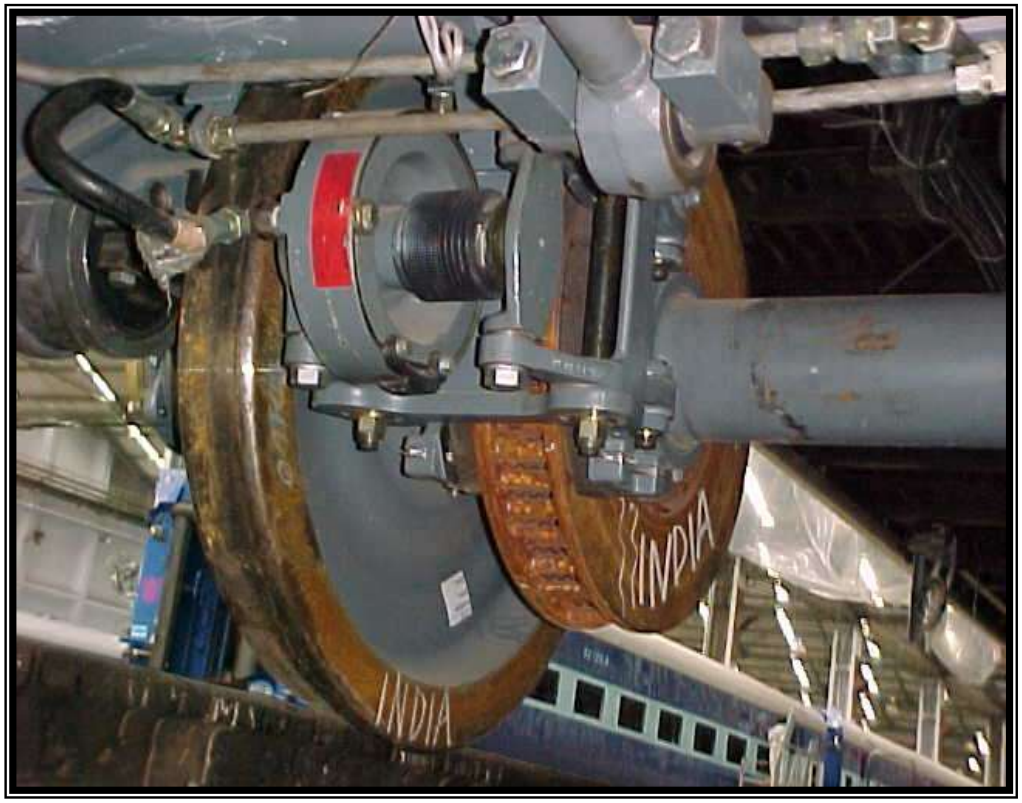
Depot Officer/DME
For DRM(M)
Inspecting agency

Copy to:-

1. CME/ Rly. for kind information
2. COS/ Rly. for kind information
3. ED/Carriage/ RDSO Manak nagar Lucknow - 226011
4. CME/ ICF Perambur, Chennai/ RCF Kapurthala & BEML Bangalore
5. COS/ ICF Perambur, Chennai/ RCF Kapurthala & BEML Bangalore
6. CWM/Workshop
7. Dy COS/Workshop for proper storage, delivery and receipt.

NOTE

CHAPTER 3



AIR BRAKE SYSTEM

CONTENTS

CHAPTER 3

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S.N	DESCRIPTION	PAGE NO.

S.N	DESCRIPTION	PAGE NO.

CHAPTER 3

AIR BRAKE SYSTEM

3.1 INTRODUCTION

In Air Brake system compressed air is used for operating the brake system. The locomotive compressor charges the feed pipe and the brake pipes throughout the length of the train. The feed pipe is connected to the auxiliary reservoirs and the brake pipe is connected to the distributor valve. Brake application takes place by dropping the pressure in the brake pipe. The schematic arrangement of the brake equipment is shown as Fig.1 (For passenger coaches), Fig.2 (For Generator coaches)

3.2 COMPONENTS OF AIR BRAKE SYSTEM

1. Brake Container (Brake Equipment Panel)
2. Distributor valve
3. Check Valve
4. Isolating Cocks (with & without vent hole)
5. Pressure Tanks (125 litres, 75 litres, 6 litres)
6. Filters
7. Test Fittings
8. Indicators
9. Angle Cocks
10. B.P./F.P. Couplings and Hoses
11. Emergency Brake Pull Box
12. Emergency Brake valve
13. Bogie Brake Equipment, consisting of-
    - Brake Discs
    - Brake Caliper Units (consisting of Brake Cylinder, Brake Calipers, Brake Pads)
14. Wheel Slide Control System, consisting of-
    - Microprocessor Control Unit,
    - Speed Sensor/Pulse Generator
    - Anti Skid Valve / Dump Valve
    - Pressure Switch

3.3 BRAKE CONTAINER (BRAKE EQUIPMENT PANEL)

3.3.1 General

The Brake Container (Brake equipment panel) consists of a Manifold on which various devices like the Distributor Valve, Cocks, Test fittings etc. are mounted. It also consists of the reservoirs required for the Brake system. The container is mounted under the car body and different lines (Feed pipe, Brake pipe, etc.) are connected to it.

3.3.2 Installation Space and Fixing Point

The overall space for the Containers is 1505 X 1330 X 712 mm. The container consists of 4 plates which are used for mounting the container under the car body. These plates are bolted to the car body with the help of 16 bolts (M10, 4 for each plate).

3.3.3 The Brake Manifold

The devices indicated under the Module plate on the piping diagram are mounted on the Brake Manifold using "O" ring joint to seal the interface connection. The devices on the manifold are protected against stone hitting by a mesh cover provided below the devices.

The connections from the manifold to the back plate of containers and the reservoirs are provided through single ferrule fittings. The pipes used for connections are of stainless steel.

3.3.4 Connections to the Container

There are 7 connections to the container for Passenger Coach,

- Feed pipe
- Brake pipe
- Brake cylinder pressure – bogie 1
- Brake cylinder pressure - bogie 2
- Indicating device – bogie 1
- Indicating device – bogie 2
- Auxiliary support pipe (for toilet)

There are two additional connections for the containers of the generator coaches,

- Support for Indicating device of handbrake
- Manometer for C- pressure.

These connections from the container to car body are provided at the back plate fitted with single ferrule fittings.

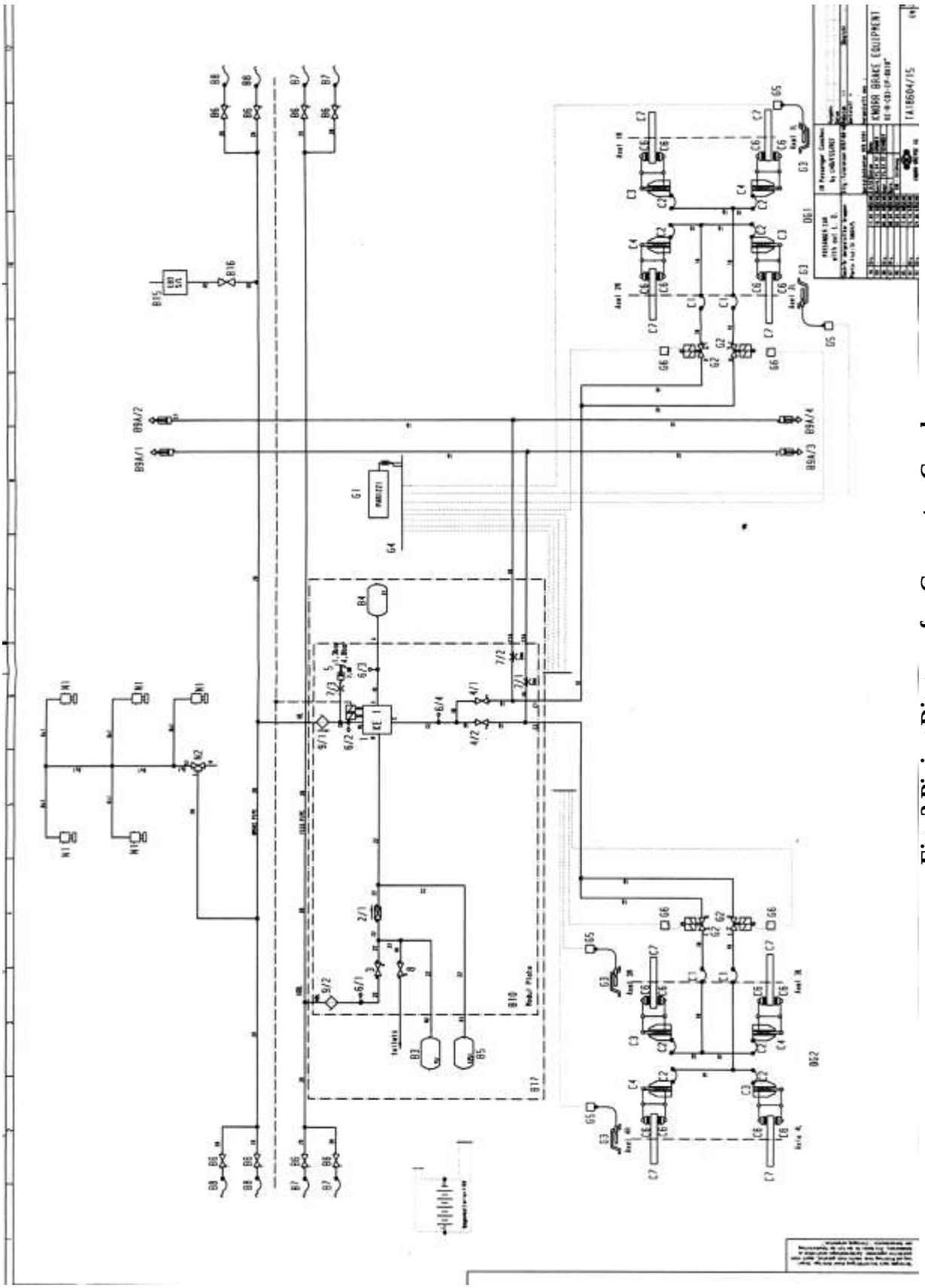


Fig: 2 Piping Diagram for Generator Coach

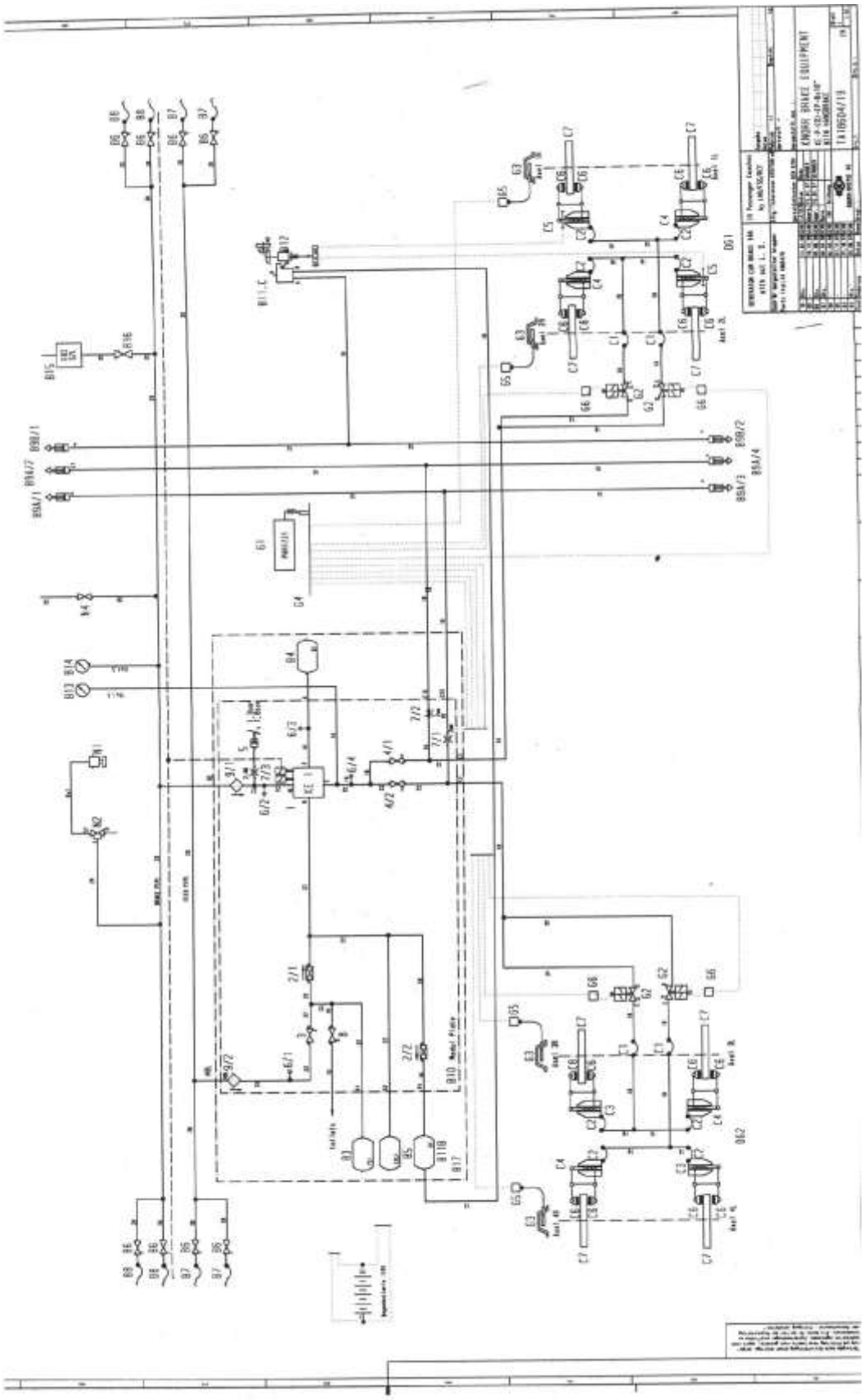


Fig: 1 Piping Diagram for Passenger Coaches

Abbreviations for Air Brake Circuit Diagram of LHB Coach						
1	**2**	**3**	**4**	**5**	**6**	**7**
Item	**Qty.**	**Unit**	**Description**	**Part Number**	**Outline drawing**	**Remarks**
B3	1	Pc.	PRESSURE TANK (75 LITERS)	II70567	C140416	
B3.1	1	Pc.	DRAIN COCK WITH NIPPLE	I.3.640/1	1.3.640/1	
B4	1	Pc.	PRESSURE TANK (06 LITERS)	C131007	C131007	
B5	1	Pc.	PRESSURE TANK (125 LITERS)	I170568	C140417	
B5.1	1	Pc.	DRAIN COCK WITH NIPPLE	I.3.640/1	1.3.640/1	
B6	8	Pc.	ANGLE COCK	1.2.411/3	1.2.411/3	
B7	4	Pc.	BRAKE PIPE COUPLING (FP)	175882/455/KI	B67285	
B8	4	Pc.	BRAKE PIPE COUPLING (BP)	175888/455/KI	B67284	
B9A	4	Pc.	INDICATOR	148102/W	A93736/A	
B.10			MANIFOLD CONSISTING OF			
B10.1	1	Pc.	DISTRIBUTOR VALVE KE1IPKSL – WITH PRESSURE CONVERTER TO PART NO II 20314 RLV-11D-E/1 & MOUNTING BRACKET	1.2.765	1.2.765	
B10.2	1	Pc.	CHECK VALVE , RV7-T	190476	4B84113	
B10.3	2	Pc.	COCK DH7-TE	188738	B80866	
B10.4	2	Pc.	COCK AHB 200 NW19	WBAHB230AA 002	WB415503-Z	
B10.5	1	Pc.	PRESSURE SWITCH MCS11W : 0.2-0.5 BAR	192268/00502	B85715	
B10.6	4	Pc.	TEST FITTING K1E	179470/07	C102830	
B10.9	2	Pc.	FIFLTER NW19 WITH CODEPIN	WBFIL100AA002	WB307519AZ	
B15	1	Pc.	EMERGENCY BRAKE ACCELERATOR EB3 S/L WITH BRAKET	189368	2B82102	
B16	2	Pc.	COCK G1-DN25E	II20882/14SX	C22541	
B17	1	Pc.	CONTAINER FRAME CONSISTING OF MANIFOLD FOR PASS./ COACH WITH ACCESSORIES FOR MOUNTING	II75530	C150857	
C1	4	Pc.	HOSE CONNECTIONR1/2E, 600 MM LONG	I.3.3503/3	1.3.3503/3	
C2	8	Pc.	HOSE CONNECTION R1/2E, 500 MM LONG	1.3.941/1	1.3.941/1	
C3	4	Pc.	BRAKE CALIPER UNIT WZ57UP10XS11 LEFT VERSION, I=2.17, FSS-NR, 1267428201	II39691/1BZA	C76300/A	

Abbreviations for Air Brake Circuit Diagram of LHB Coach						
1	**2**	**3**	**4**	**5**	**6**	**7**
Item	**Qty.**	**Unit**	**Description**	**Part Number**	**Outline drawing**	**Remarks**
			INCLUDING : BRAKE CALIPER BRAKE CYLINDER	 II39700/ZA 170285/704LP	 C76301/A C88079/2	
C4	4	Pc.	BRAKE CALIPER UNIT WZ57UP10XS11 RIGHT VERSION, I=2.17, FSS-NR, 1267529201	II39691/2BZA	C76300/A	
			INCLUDING : BRAKE CALIPER BRAKE CYLINDER	 II39700/ZA 170285/304LP	 C76301/A C88079/2	
C6A	8	SET	BRAKE PAD 200 CM2 LEFT	C105255/3571X	C105255	
C6B	8	SET	BRAKE PAD 200 CM2 RIGHT	C105255/3571X	C105255	
C7	8	Pc.	Brake Disc W640B110PGUP FSS-NR 1267299202	193290/1990	B83756/1	
N2	1	Pc.	Emergency Brake Valve NB-12A	I94023/A	2C63437	
			KNORR ANTI-SKID			
G1	1	Pc.	Control Unit MGS2	STN30518/ 0276	TA28601/200	
	1	Pc.	Connector	STN 30979		
G5	4	Pc.	Speed Sensor G16	II35456/ 20013	N52240	
G2	4	Pc.	Dump Valve GV12-ESRA	II34652/ 15024	C64539	
	4	Pc.	Connector (Plug)	N62148/ 10000	N63467	
	4	Pc.	Nut	463376	MPG13.5, DIN46320	
G3	4	Pc.	Toothed wheels	1.2.748	1.2.748	
	150	Meter	Complete length of wiring Required for Anti Skid System – (1 mm x3 core, with sheath)	I.F.2903I.A.1109	I.F.2903	
	4	Pc.	Junction Box (Speed Sensor)	I.A.1110	I.A. 1109	
	2	Pc.	Junction Box (Dump Valve)	B61607	I.A.1110	
	4	Pc.	Housing		C90305	

Abbreviations for Air Brake Circuit Diagram of LHB Coach (POWER CAR)						
1	**2**	**3**	**4**	**5**	**6**	**7**
Item	**Qty.**	**Unit**	**Description**	**Part Number**	**Outline drawing**	**Remarks**
B3	1	Pc.	PRESSURE TANK (75 LITERS)	II70567	C140416	
B3.1	1	Pc.	DRAIN COCK WITH NIPPLE	I.3.640/1	1.3.640/1	
B4	1	Pc.	PRESSURE TANK (06 LITERS)	C131007	C131007	
B5	1	Pc.	PRESSURE TANK (125 LITERS)	I170568	C140417	
B5.1	1	Pc.	DRAIN COCK WITH NIPPLE	I.3.640/1	1.3.640/1	
B6	8	Pc.	ANGLE COCK	I.2.411/3	1.2.411/3	
B7	4	Pc.	BRAKE PIPE COUPLING (FP)	175882/455/KI	B67285	
B8	4	Pc.	BRAKE PIPE COUPLING (BP)	175888/455/KI	B67284	
B9A	4	Pc.	INDICATOR	148102/W	A93736/A	
B9B	2	Pc.	INDICATOR	148102/W		
B.10			MANIFOLD CONSISTING OF :			
B10.1	1	Pc.	DISTRIBUTOR VALVE KE1IPKSL – WITH SUITABLE RELAY VALVE & MOUNTING BRACKET	I.2.765	1.2.765	
B10.2	2	Pc.	CHECK VALVE , RV7-T	190476	4B84113	
B10.3	2	Pc.	COCK DH7-TE	188738	B80866	
B10.4	2	Pc.	COCK AHB 200 NW19	WBAHB230AA002	WB415503-Z	
B10.5	1	Pc.	PRESSURE SWITCH MCS11W : 0.2-0.5 BAR	192268/00502	B85715	
B10.6	4	Pc.	TEST FITTING K1E	179470/07	C102830	
B10.8	1		COCK DH7-TE	188738	B80866	
B10.9	2	Pc.	FIFLTER NW19 WITH CODE PIN	WBFIL100AA002	WB307519 AZ	
B10.10	1	Pc.	MANIFOLD FOR PASS. / GEN. COACH WITH ACCESSORIES FOR MOUNTING	II71579	C142633	
B11.B	1	Pc.	PRESSURE TANK 06 LITERS	C131002	C131002	
B11.C	1	Pc.	ROLLER LEVER VALVE WRV -2S, G ¼”	177338	A70429	
B11.D	2	Pc.	FLEXIBLE HOSE WITH ADAPTOR	I.F.2744	I.F.2744	
B13	1	Pc.	PRESSURE GAUGE 80X10	II55801/10-001	C108950	

Abbreviations for Air Brake Circuit Diagram of LHB Coach (POWER CAR)						
1	**2**	**3**	**4**	**5**	**6**	**7**
Item	**Qty.**	**Unit**	**Description**	**Part Number**	**Outline drawing**	**Remarks**
				(BC)		
B14	1	Pc.	PRESSURE GAUGE 80X10	II55801/10-001 (BP)	C108950	
B14.1	1	Pc.	PRESSURE GAUGE 80X10	II55801/10-001 (FP)	C108950	
B15	1	Pc.	EMERGENCY BRAKE ACCELERATOR EB3 S/L WITH BRAKET	189368	2B82102	
B16	2	Pc.	COCK G1-DN25E	II20882/14SX	C22541	
B17	1	Pc.	CONTAINER FRAME CONSISTING OF MANIFOLD FOR GENERATOR CAR WITH ACCESSORIES FOR MOUNTING	II75531	C150858	
C1	4	Pc.	HOSE CONNECTION R1/2E, 600 MM LONG	I.3.3503/3	1.3.3503/3	
C2	8	Pc.	HOSE CONNECTION R1/2E, 500 MM LONG	1.3.941/1	1.3.941/1	
C3	2	Pc.	BRAKE CALIPER UNIT WZ57UP10XS11 LEFT VERSION, I=2.48 FSS-NR, 1272114201	II39261/1BZA	C76302/A	
			INCLUDING : BRAKE CALIPER BRAKE CYLINDER	 II39601/ZA 170285/704LP	 C76299/A C88079/2	
C4	4	Pc.	BRAKE CALIPER UNIT WZ57UP10XS11 RIGHT VERSION, I=2.17, FSS-NR, 1267529201	II39261/2BZA	C76302/A	
			INCLUDING : BRAKE CALIPER BRAKE CYLINDER	II39601/ZA 170285/304LP	C76299/A C88079/2	
C5A	2	Pc.	BRAKE CALIPER UNIT WZ57UP10H16R8 LEFT VERSION, W. HANDBRAKE I=2.48, FSS-NR, 126758421	II39260/1BZA	C76298/A	
			INCLUDING : BRAKE CALIPER BRAKE CYLINDER	II39601/ZA 170286/1204LP	C76299/A C88077/2	
C5B	2	Pc.	CONNECTING PARTS FOR FLEXIBLE 125	II17430125	2C57907/125	

Abbreviations for Air Brake Circuit Diagram of LHB Coach (POWER CAR)						
1	**2**	**3**	**4**	**5**	**6**	**7**
Item	**Qty.**	**Unit**	**Description**	**Part Number**	**Outline drawing**	**Remarks**
C6A	8	SET	BRAKE PAD 200 CM2 LEFT	C105255/3571X	C105255	
C6B	8	SET	BRAKE PAD 200 CM2 RIGHT	C105255/3571X	C105255	
C7	8	Pc.	Brake Disc W640B110PGUP FSS-NR 1267299202	193290/1990	B83756/1	
N2	1	Pc.	Emergency Brake Valve NB-12A	I94023/A	C63437	
N4	1	Pc.	GUARD"S EMERGENCY ISOALTING COCK	I39369/KI	3A81344/KI	
F1	2	Pc.	FLEXBALL CABLE (L= 2197 MM)	I-6352078E01	2SK10.6176	
F3	1	Pc.	FLEXBALL CABLE (L= 4024MM)	I-6352073E01	0267.05.00.00	
F2	1	Pc.	FLEXBALL CABLE (L= 2333 MM)	I-6352072E01	0267.06.00	
			KNORR ANTI-SKID			
G1	1	Pc.	Control Unit MGS2	STN30518/ 0276	TA27601/200	
	1	Pc.	Connector	STN 30979		
G5	4	Pc.	Speed Sensor G16	II35456/ 20013		
G2	4	Pc.	Dump Valve GV12-ESRA	II34652/ 15024		
	4	Pc.	Connector (Plug)	N62148/ 10000		
	4	Pc.	Nut	463376		
G3	4	Pc.	Toothed wheels	1.2.748		
	150	Meter	Complete length of wiring Required for Anti Skid System – (1 mm x 3core, with sheath)	I.F.2903		
	4	Pc.	Junction Box (Speed Sensor)	I.A.1109		
	2	Pc.	Junction Box (Dump Valve)	I.A.1110		
	4	Pc.	Housing	B61607		

3.4 DISTRIBUTOR VALVE (KBI TYPE))

A. KE -1 Distributor Valve (With Relay Valve)

1.0 General

All components of KE-1 distributor valve are united in one package which can be removed as a whole from the common pipe bracket. The common pipe bracket facilitates connections to all the pneumatic pipes / lines in the vehicle. The distributor valve can be detached from the common pipe Bracket easily.
The KE-1 distributor valve is a variant of KE Series valves. KE-1 distributor valve has a universal action, which is achieved by using a modular Relay Valve KR-1d (in place of simple side cover in earlier variants). A "universal action" means the brake application and release times are independent of the brake cylinder size (volume), which means the same distributor valve can be used with different sizes of brake cylinder.

2.0 Isolating and Emptying all Pressure Chambers

The auxiliary reservoir ACCOMMODATE charging valve or R charger contains an isolating valve. Actuating this valve by its handle interrupts communication between distributor valve and brake pipe, and simultaneously exhausts the aux. reservoir, brake cylinder and all the pressure chambers in the distributor valve.

3.0 Components of KE-1 Distributor Valve

i) Basic Valve Body

The basic valve body (1) incorporates the following assemblies –

ii) Intermediate Flange

The Intermediate flange is an adopter part of the distributor valve for matching common pipe bracket. When the distributor valve is detached from the Common pipe bracket, the Int. flange can be immediately removed.

iii) Three-Pressure Valve

The three-pressure valve G controls brake cylinder charging and discharging according to the changes in the brake pipe pressure. The three-pressure valve G has a fast response to controlled changes in the brake pipe pressure, making for a very fast brake reaction. Further, the three-pressure valve G activates the accelerator and controls overcharge protection.

iv) Accelerator

The accelerator consists of a quick-service control valve U with a quick-service chamber K, a control sleeve and a choke switch H. At the start of braking, air from the brake pipe flows into the quick-service (K) chamber. This action of volume expansion causes an initial pressure reduction and propagates the braking pulse quickly through the train. A propagation rate of 285 m/s is hence achieved in trains fitted with KE distributor valves.

v) A-Controller

The control reservoir pressure A, (which is derived from the brake pipe pressure L via A- controller valve D) is monitored by the pre-control pressure C_V. Since the choke switch H is linked to the accelerator, the brake is reliably protected against any exhausting of the control pressure A. The accelerator is therefore restored to readiness at the end of brake release

vi) Minimum Pressure Limiter

When the brakes are applied, the minimum pressure limiter F causes the brake cylinder to charge quickly to about 10% of the brake force reached in a full service brake application. In this way the friction in the brake rigging is overcome as quickly as possible and the brakes shoes are brought into brake position with certain brake shoe force. This pressure increase in the brake cylinder up to the minimum pressure is called the response.

vii) Maximum Pressure Limiter

The brake cylinder pressure is set to its highest level by the maximum pressure limiter E, irrespective of the size and pressure of the auxiliary reservoir (AR) and the brake cylinder volume. The maximum pressure limiter hence stops over braking and prevents wheel flats.

Air losses in the supply lines to the brake cylinder or in the brake cylinder itself will be re-fed by reserve in the auxiliary reservoir. In Twin pipe systems the auxiliary reservoir pressure is maintained higher than the working pressure, without the maximum permissible brake cylinder pressure being increased.

viii) Choke Cover

The choke cover (5) contains brake application and release chokes in a single component. These are meant for controlling brake application and release timings.

ix) R Charger- Valve

The distributor valve KE-1 is fitted with an R-Charger (4) having a isolating valve & the check valve. When the brakes are released, the auxiliary reservoir R is replenished with compressed air from the brake pipe L via the L-R check valve; replenishment is simultaneous. The auxiliary reservoir is separated from the brake pipe L via a check valve in the R charger.

x) Relay Valve

In distributor valve KE-1, a single-stage relay valve KR-1d with a transmission ratio of 1:1 is used instead of the Side cover. KE-1 distributor valves equipped with a KR-1d relay valve have a universal action; i.e. the brake application and release times are independent of the brake cylinder volume. This means that one and the same distributor valve can

be used for different brake cylinder sizes and piston strokes without any special modification (change of chokes).

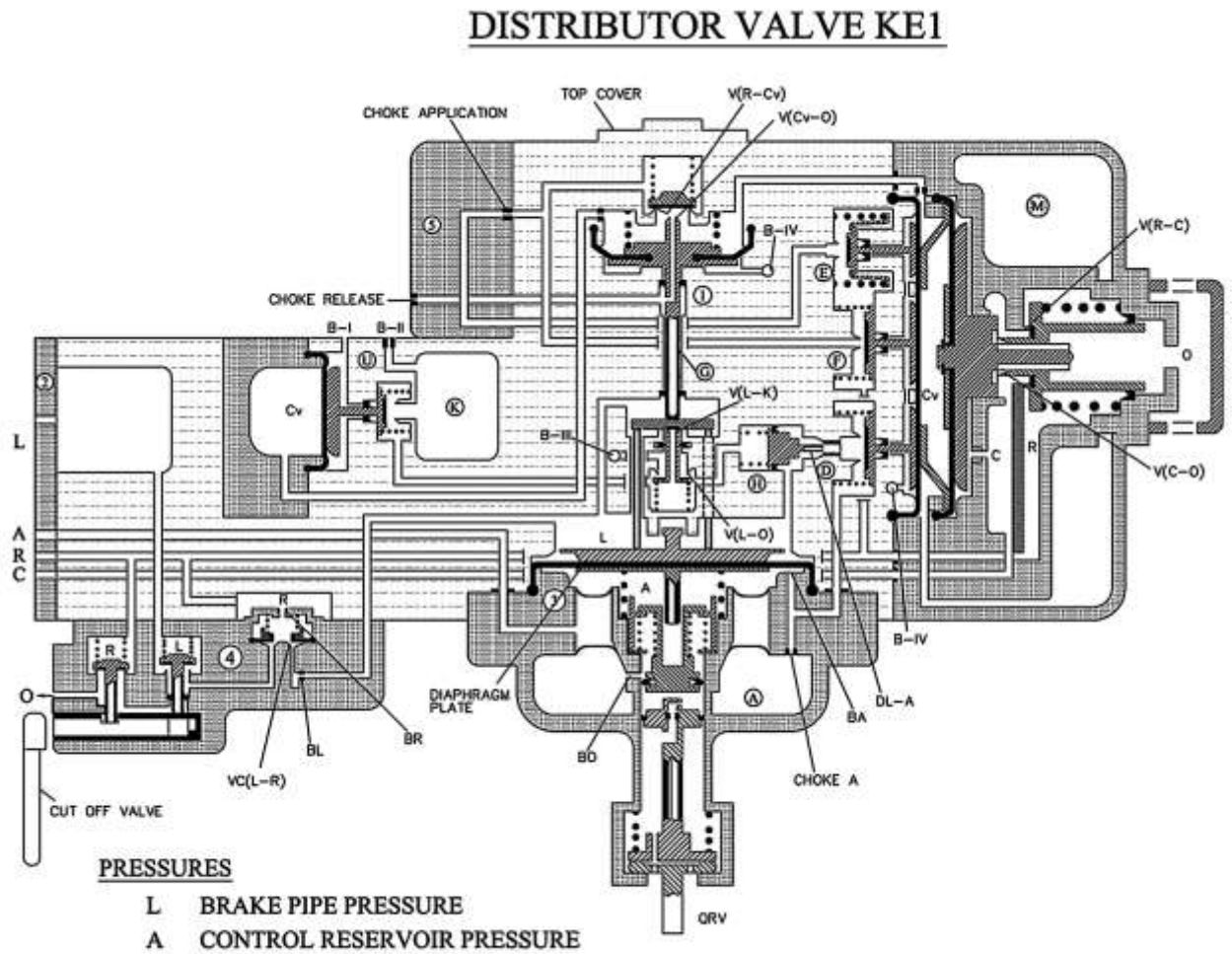
xi) Quick Release Valve

Briefly pulling the release mechanism once releases the vehicle brakes via the quick release valve, without losing pressure in the auxiliary reservoir. The vehicle‟s braking capability is hence preserved. The quick release valve is attached to the control reservoir A cover (bottom cover).

xii) Isolating Valve

The isolating valve is part of the R charger (4) and can be actuated directly on the distributor valve of the vehicle.

The isolating valve serves to switch the brakes of a vehicle on and off and, when switching off, simultaneously exhaust all pressure chambers and the brake cylinders (i.e. – AR, CR &BC).



PRESSURES

L	BRAKE PIPE PRESSURE
A	CONTROL RESERVOIR PRESSURE
R	AUXILIARY RESERVOIR PRESSURE
C	BRAKE CYLINDER PRESSURE
Cv	B.C. PRE-CONTROL PRESSURE
O	EXHAUST TO ATMOSPHERE

FUNCTIONAL ASSEMBLIES

D	A CONTROLLER VALVE
E	MAXIMUM PRESSURE LIMITER
F	MINIMUM PRESSURE LIMITER
G	THREE PRESSURE VALVE
H	CHOKE SWITCH
K	QUICK SERVICE (U) CHAMBER
U	QUICK SERVICE (U) CONTROL VALVE
M	RELAY VALVE

COMPONENTS

1	BASIC VALVE BODY
2	INTERMEDIATE FLANGE
3	BOTTOM COVER WITH QUICK RELEASE VALVE
4	R CHARGER
5	CHOKE COVER

PARTS

B - PORTS
V - VALVES
Vc - CHECK VALVES

NOTE:-

COMMON PIPE BRACKET WITH CONTROL CHAMBER S/A NOT SHOWN

Figure: 3.1 Isolating Valve

OPERATION OF KE- 1 DISTRIBUTOR VALVE-

Charging (Refer Fig.-3.2)

All the pressure chambers in the valve are unloaded.

- The three-pressure valve G is in the release position.
- The inlet valve (R-C_V) is closed, the outlet (C_V-O) open
- The control reservoir (A) control valve D is open. The minimum pressure limiter F and the maximum pressure limiter E are open. These valves are open due to respective compression springs.
- The relay valve (M) is at the release position; the inlet valve from R to C is closed due to respective Compression spring, the outlet valve from C to O is open.
- In the R charger, the path to L is closed and R exhausted to atmosphere „O" on account of the cut-off valve; the check valve L-R is closed.
- The chamber above the diaphragm plate is filled (see Fig.-2) when the cut-off valve is opened and the L pressure increased to working level.
- The choke switches (H) moves against the force of the spring and compressed air from L flows into the control reservoir A through the choke.
- The L pressure pushes the diaphragm plate down onto the cup diaphragm (99) with diaphragm supporting plate The pin travels downwards across the exhaust port BO and cuts off A from O.
- The cup diaphragm (99) closes the port BA under the action of the pressure difference L-A.
- The control reservoir A is now charged through the restricting choke-A.
- Air from the brake pipe flows through the check valve in the R charger to both the auxiliary air reservoir and the inlet valve in the relay valve M
- R air flows without any restriction through the minimum pressure limiter F to the inlet valve (R-C_V) in top cover.
- R air also passes through the open maximum pressure limiter E to the application chokes.

Fully Charged Condition

When the normal working pressure is reached in pressure chambers L, R an A, the distributor valve is at the fully charged position. The distributor valve is now ready to brake at its normal response rate. At the fully charged position, the distributor valve maintains the pressure relative to R and A; pressure losses in the auxiliary reservoir are corrected via the R choke port BR and the check valve Vc (L-R).

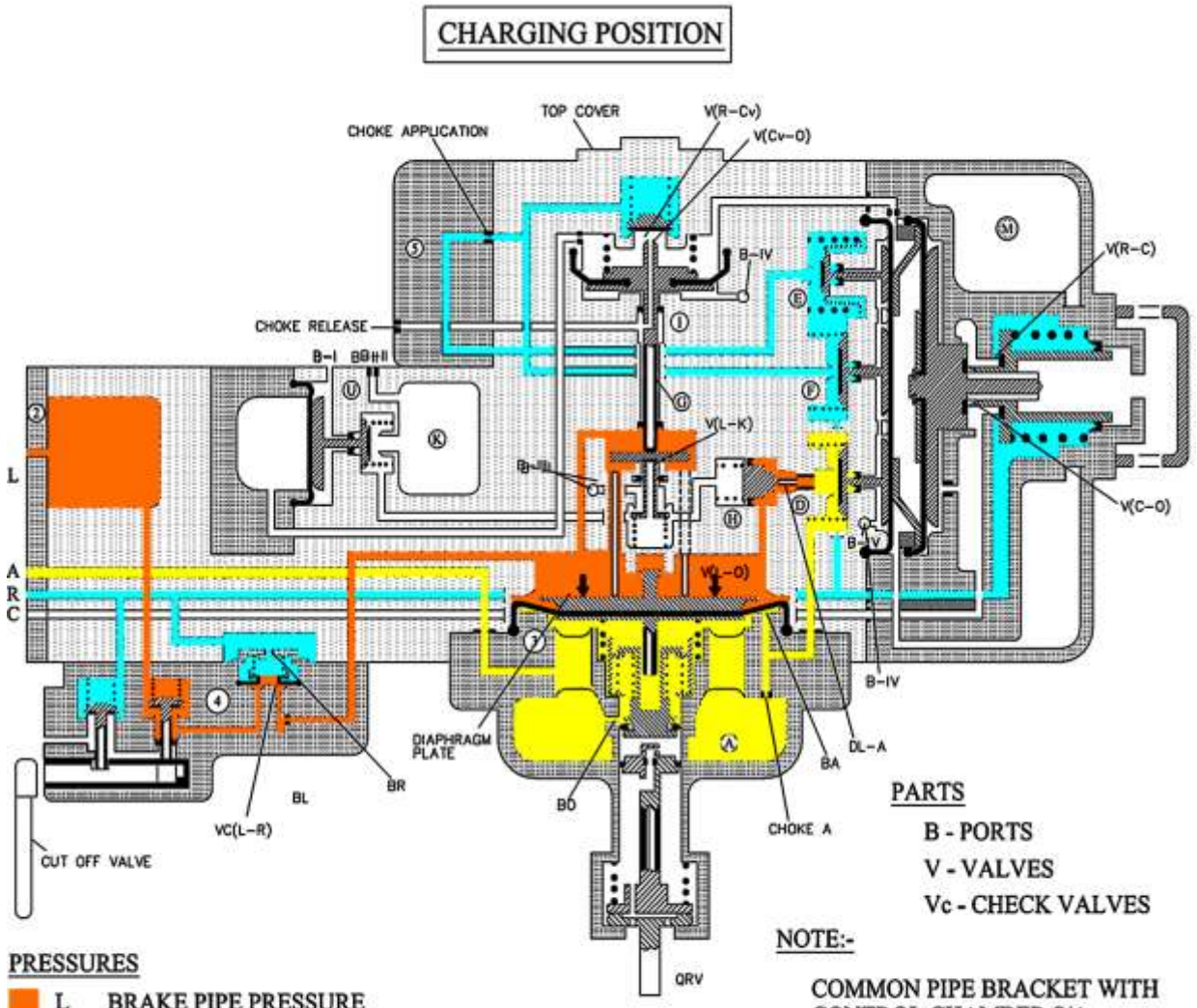

CHARGING POSITION
TOP COVER
V(R-Cv)
V(Cv-O)
CHOKE APPLICATION
V(R-C)
B-IV
CHOKE RELEASE
B-I
B-II
V(L-K)
V(C-O)
L
A
R
C
DIAPHRAGM PLATE
BR
BL
VC(L-R)
CUT OFF VALVE
BD
BA
DL-A
CHOKE A
QRV
PARTS
B - PORTS
V - VALVES
Vc - CHECK VALVES
NOTE:-
COMMON PIPE BRACKET WITH CONTROL CHAMBER S/A NOT SHOWN
PRESSURES
L BRAKE PIPE PRESSURE
A CONTROL RESERVOIR PRESSURE
R AUXILIARY RESERVOIR PRESSURE
C BRAKE CYLINDER PRESSURE
Cv B.C. PRE-CONTROL PRESSURE
O EXHAUST TO ATMOSPHERE
FUNCTIONAL ASSEMBLIES
D A CONTROLLER VALVE
E MAXIMUM PRESSURE LIMITER
F MINIMUM PRESSURE LIMITER
G THREE PRESSURE VALVE
H CHOKE SWITCH
K QUICK SERVICE (U) CHAMBER
U QUICK SERVICE (U) CONTROL VALVE
ELAY VALVE
COMPONENTS
1 BASIC VALVE BODY
2 INTERMEDIATE FLANGE
3 BOTTOM COVER WITH QUICK RELEASE VALVE
4 R CHARGER
5 CHOKE COVER

Figure: -3.2

Brake Application (Refer Fig.-3.3)

The brake response obtained when the L pressure is lowered for a service brake application depends on the maximum amount of compensation L-A allowed through the choke BL in R- charger.

- If the L pressure has been lowered so much that a large enough pressure difference is created between L and A at the main diaphragm plate, the valve plate will be lifted via the three valve pins. Since the control sleeve can only follow the motion until the valve (control sleeve) is closed, the valve (between control sleeve & round valve plate) opens and allows L to communicate with the quick-service chamber through the inlet of the quick-service (U) control valve (U-Controller).

- Since communication between the L chamber in the distributor valve and the brake pipe is restricted by the BL choke port (R charger), the L air expands and generates a greater pressure difference L-A at the main diaphragm plate ; the three-pressure valve G moves faster to the upper application position.

- When the valve (L-K) opens, a pressure is formed which charges the choke switch H from behind and allows the force of its compression spring to move the choke switch to the cut- off position (L-A.).

The distributor valve is switched over in this way from normal to elevated response.
The C_V pressure builds up through the open valve (R-CV) in top cover and the initially open minimum pressure limiter F and maximum pressure limiter E.

In distributor valves equipped with relay valves (KE-1d) the C_V pressure is passed to the relay valve M, closing the outlet valve (C-O) and then opening the inlet valve ((R-C).

The pressure gradient between the brake pipe and the L chamber drops as the quick-service (U) chamber K is charged. As soon as the gradient has reached a level equivalent to a steady flow, the triple-pressure valve G travels from the upper to the lower brake application position.

NOTE - The pressure gradient is created at the BL choke port (R Charger) because the L chamber is vented through the control sleeve, the valve in the quick-service (U) control valve, the quick-service (U) chamber K and the choke of B-II (port -2).

- The C_V pressure closes the control reservoir (A) control valve D(A-controller) as soon as pressure builds up at C_V , this cuts off the path from A to L.

The distributor valve is switched over in this way from normal to absolute response; the control pressure A is stored.

- At the end of the time delay maintained by the choke (top cover), the quick-service (U) control valve (U-controller) closes the valve at a similar pressure as above in the Cv control chamber of the quick-service (U) control valve, this ends acceleration. Possible leakage from the valve is offset via L. The choke switch H is kept at the cut-off position by the force of the compression spring.

Since the start of braking, the pressure chambers L and R have been kept apart by the check valve (R charger) because the L pressure is lower than the R pressure.

- The rise in C_V pressure causes the inlet valve (R-C) to open in the relay valve M.

Since the transmission ratio of relay valve KR-1d is C_V : C = 1 : 1, every increase in the C_V pressure makes an equivalent change in the C pressure.

- At a C_V pressure of about 0.8 kg/cm^2 the minimum pressure limiter F closes and the C_V pressure continues rising entirely through the maximum pressure limiter E and the application choke, as the pressure continues to fall in the brake pipe.

The speed at which the Cv pressure builds up depends firstly on the rate at which the L pressure falls in the brake pipe, secondly on how the application chokes are set (for Goods / Passenger).

Application – Lap Condition

- When a state of equilibrium is reached between L and Cv, the three-pressure valve G travels to the application lap position.

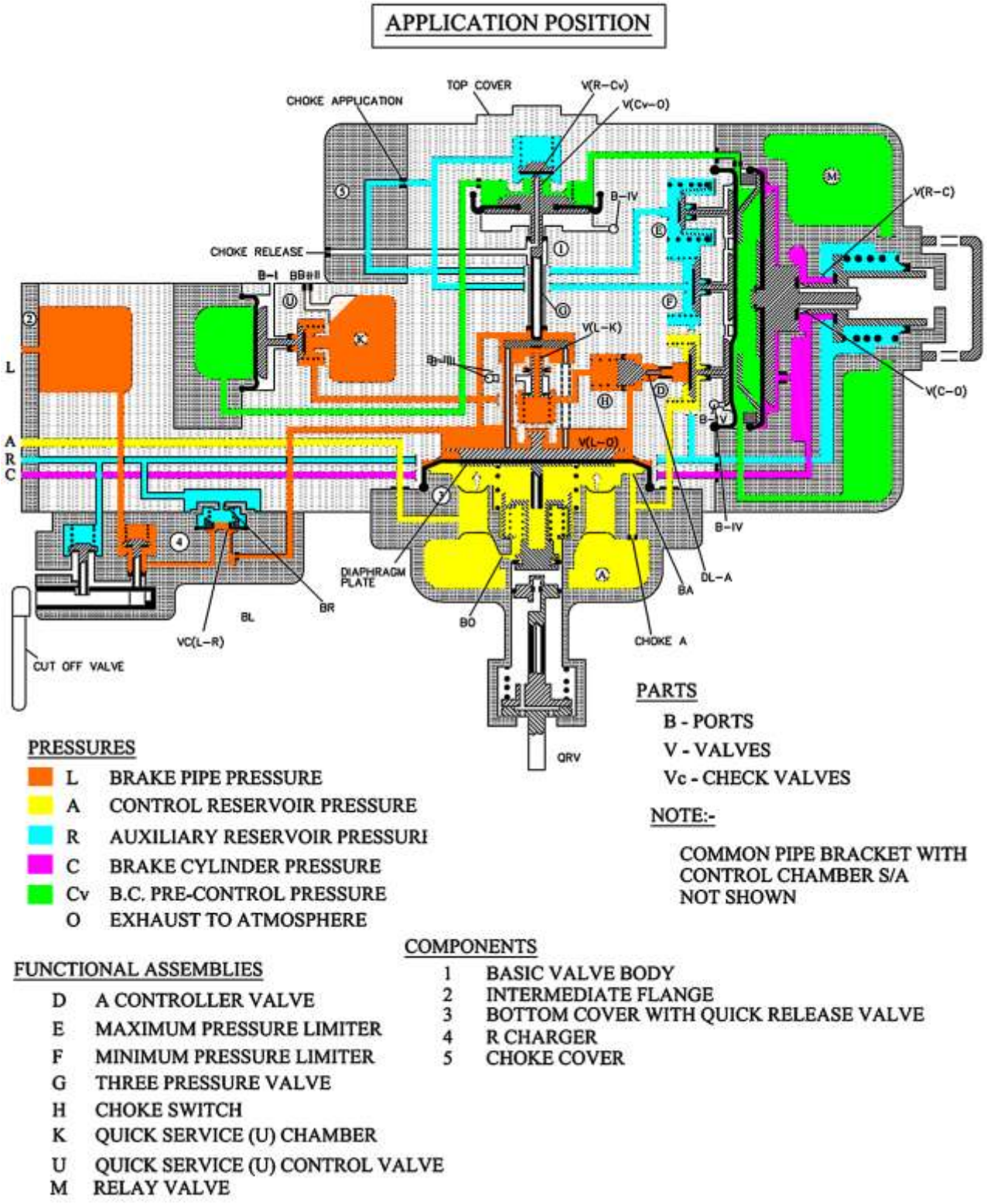
This action cuts off the connection R-Cv and Cv-O as well as R-C and C-O in the relay valve. Every further pressure drop in the brake pipe (up to maximum of 1.5 kg/cm^2 = full service brake application) denotes an increase in Cv pressure. The response is absolute because L is cut off from A. The valve hence responds to slow or slight changes too in the brake pipe pressure.

Within the limits of the given pressure gradients, the valve help maintain pressure at the application, lap position as well. Leaks from C to O in distributor valves KE1 are corrected from R by the relay valve. Leakage from Cv to O in distributor valves is corrected from R via the maximum pressure limiter E.

R is, if necessary, replenished from L via the check valve (R charger). The relay valve discharges to "O "any leakages from R to C in distributor valves KE1 and leaks from R to C_V are discharged to O via the valve(c-o) in top cover.

- When the brake pipe pressure is lowered to below the level equivalent to a full service brake application e.g. in an emergency application, the three-pressure valve G travels from the application position, thereby opening the valve TPV (path from R to C_V). However, the maximum pressure limiter E will stop any further increase in C pressure.

The pressure compensation conditions are all the same, with the exception of the pressure R being maintained from L In single pipe system and directly from feed pipe in twin pipe system.


APPLICATION POSITION
TOP COVER
V(R-Cv)
V(Cv-O)
CHOKE APPLICATION
CHOKE RELEASE
B-I
BB#II
B-IV
V(R-C)
V(L-K)
B-III
V(C-O)
V(L-O)
B-V
B-IV
DIAPHRAGM PLATE
BA
DL-A
BO
CHOKE A
BL
BR
VC(L-R)
CUT OFF VALVE
QRV
L
A
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C
PRESSURES
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R AUXILIARY RESERVOIR PRESSURI
C BRAKE CYLINDER PRESSURE
Cv B.C. PRE-CONTROL PRESSURE
O EXHAUST TO ATMOSPHERE
PARTS
B - PORTS
V - VALVES
Vc - CHECK VALVES
NOTE:-
COMMON PIPE BRACKET WITH CONTROL CHAMBER S/A NOT SHOWN
FUNCTIONAL ASSEMBLIES
D A CONTROLLER VALVE
E MAXIMUM PRESSURE LIMITER
F MINIMUM PRESSURE LIMITER
G THREE PRESSURE VALVE
H CHOKE SWITCH
K QUICK SERVICE (U) CHAMBER
U QUICK SERVICE (U) CONTROL VALVE
M RELAY VALVE
COMPONENTS
1 BASIC VALVE BODY
2 INTERMEDIATE FLANGE
3 BOTTOM COVER WITH QUICK RELEASE VALVE
4 R CHARGER
5 CHOKE COVER

Figure: -3.3

Brake Release (Refer Fig-3.4)

If the pressure in the brake pipe is increased from the application lap condition, the A-L pressure difference at the Main diaphragm plate will be reduced and the three-pressure system restored to equilibrium through the C_V vent.

Distributor Valve with Relay Valve

The outlet valve (C – O) of relay valve M will vent the brake cylinder to O if, during release, the brake pipe pressure is raised to the normal working level.

As the Cv pressure continues to drop, first the minimum pressure limiter F opens upon reaching a level below the minimum brake cylinder pressure, while the A control valve D opens latter. However, the path from L to A is still restricted by the choke switch H, so the A pressure can assimilate only slowly to the L pressure. The quick service (U) control valve U remains closed on account of the L pressure still weighing on its valve head. The valve has an increased response but the accelerator is not yet operative again, depending on the actual L-R pressure difference, the auxiliary air reservoir is replenished via the R choke port during the whole of brake release.

So during release, the auxiliary air reservoir receives just enough air from the brake pipe supply to keep the brake inexhaustible. The remaining amount is utilized to increase the brake pipe pressure evenly and more quickly throughout the train.

The release time of the distributor valve is defined by the rate at which the pressure rises in the brake pipe, but if L rises faster than C_V can be vented through the release chokes then the latter define the rate at which Cv is exhausted.

Brake Release

The compression spring (TPV) finally moves the three-pressure valve G further towards the release position after the A pressure has adjusted to L and the brake pipe pressure has risen still further.

- The control sleeve (MAIN BUSH) is pushed to the lower end position, thereby venting the chamber leading to the quick-service (U) control valve U and choke switch H.
- As a result, the quick service (U) control valve U opens the valve Vu and re-activates the quick-service (U) chamber K.
- Since the choke switch H is vented via the control sleeve, it moves away from its cut-off position.

The A and L pressure rise in synchronism to the normal working level. If the brake pipe pressure falls again after the quick-service (U) control valve has opened, the distributor valve regains its original brake response and the accelerator is simultaneously activated.

On distributor valves with a relay valve, the relay valve M vents the brake cylinder proportionately to the drop in Cv pressure.

After the control reservoir (A) control valve D has opened, the lower A pressure assimilates to the higher L pressure.

- Owing to the high L pressure caused by the pressure surge, the port „BA" (Bottom Cover) is closed by the cup diaphragm (99), with the result that the A pressure can only build up slowly through the choke A (CR charging coke in bottom cover).

This measure provides overcharge control since the A pressure can only building up slowly; there is less risk of the control reservoir A being overcharged.

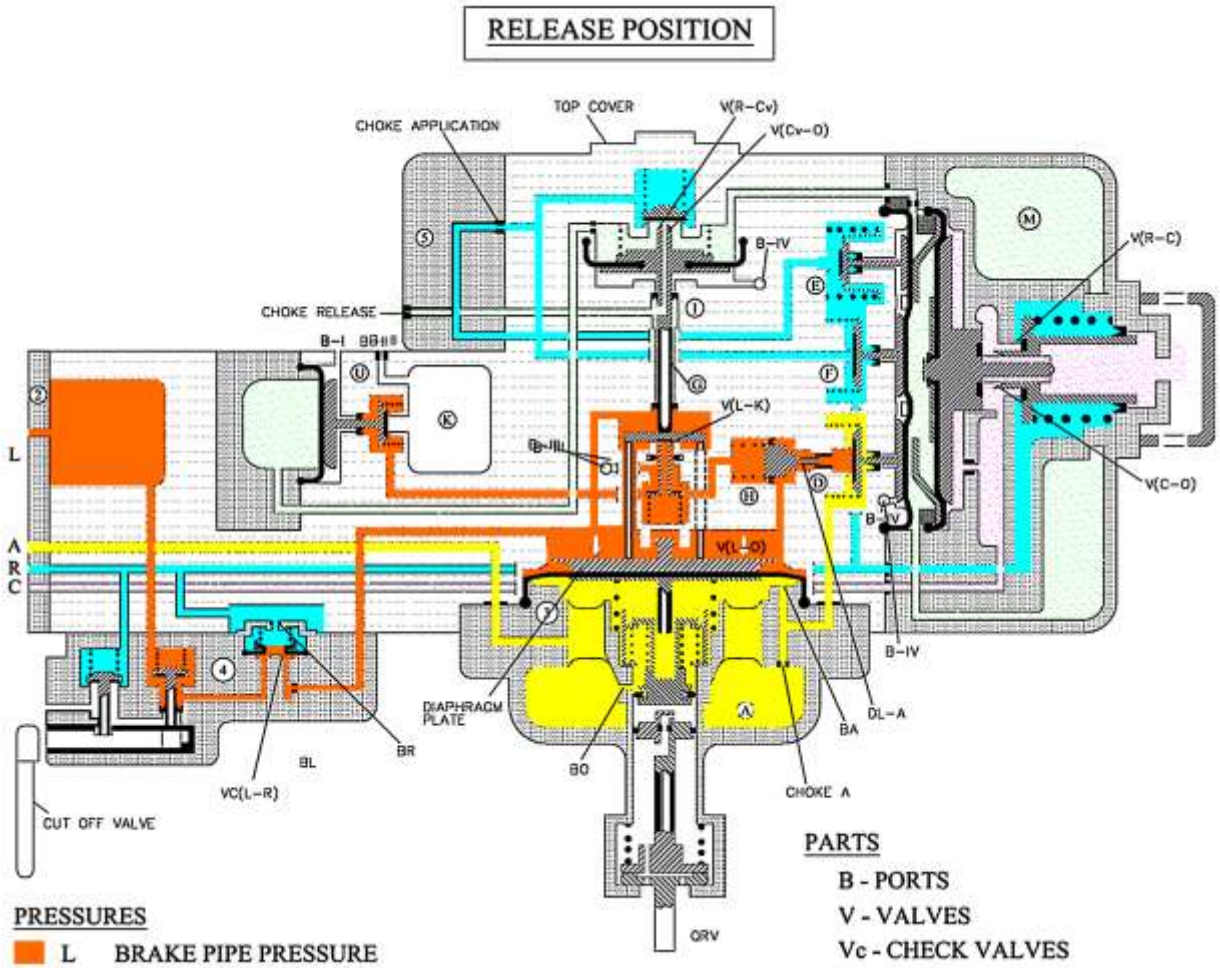


Figure: -3. 4

Quick Release Valve (Fig.3.5)

The quick release valve serves both to fully release the brake automatically and to adjust an elevated A pressure to the L pressure.

- Brake release is by briefly pulling the handle on the quick release valve. This movement deflects the thrust member, moves the push rod against the force of the compression spring and lifts the pin sub, assy. with compression spring and sleeve.
- Air now flow through the port Bo under the pin, holding the latter and the sleeve at the very top position with the assistance of the compression spring.
- When the handle is released, the thrust member and handle return to their initial positions.
- The control reservoir A is vented through the exhaust port BO. As a result, the three- pressure valve G travels downwards to the release position, and Cv is vented through the valve (Cv-O) and the release choke in the choke cover.
- Upon refilling, the L pressure rises and pushes the pin assy. to the lap position by way of the cup diaphragm (99) and the supporting plate; BO is hence cut off from O.
- Pulling the QRV handle serves also to dissipate overcharges. The control reservoir A is vented through the port BO until the L pressure pushes the pin assy. downwards across the port BO by way of the cup diaphragm and the diaphragm supporting plate, BO is hence cut from O.
- The A pressure now charges the pin from above and moves it to the lap position. The supporting plate is no longer engaged by friction.

Isolating the Brake

To isolate the brake, you must set the isolating handle to the OFF position by lifting. The action of the control shaft closes the valve (L), opens the valve (R) and vents the auxiliary reservoir R to O.

The L pressure in the valve follows the course of the R pressure by way of the check valve. As the R pressure falls, the maximum pressure limiter E opens and the pre-control pressure C_V can exhaust to R via the valve (TPV), the application choke and the maximum pressure limiter E.

On distributor valves with a relay valve, the drop in C_V pressure opens the outlet valve (C-O) and hence exhaust C to O.

Finally, the control reservoir (A) control valve D (A-controller) opens, allowing A pressure to discharge to L and to O.

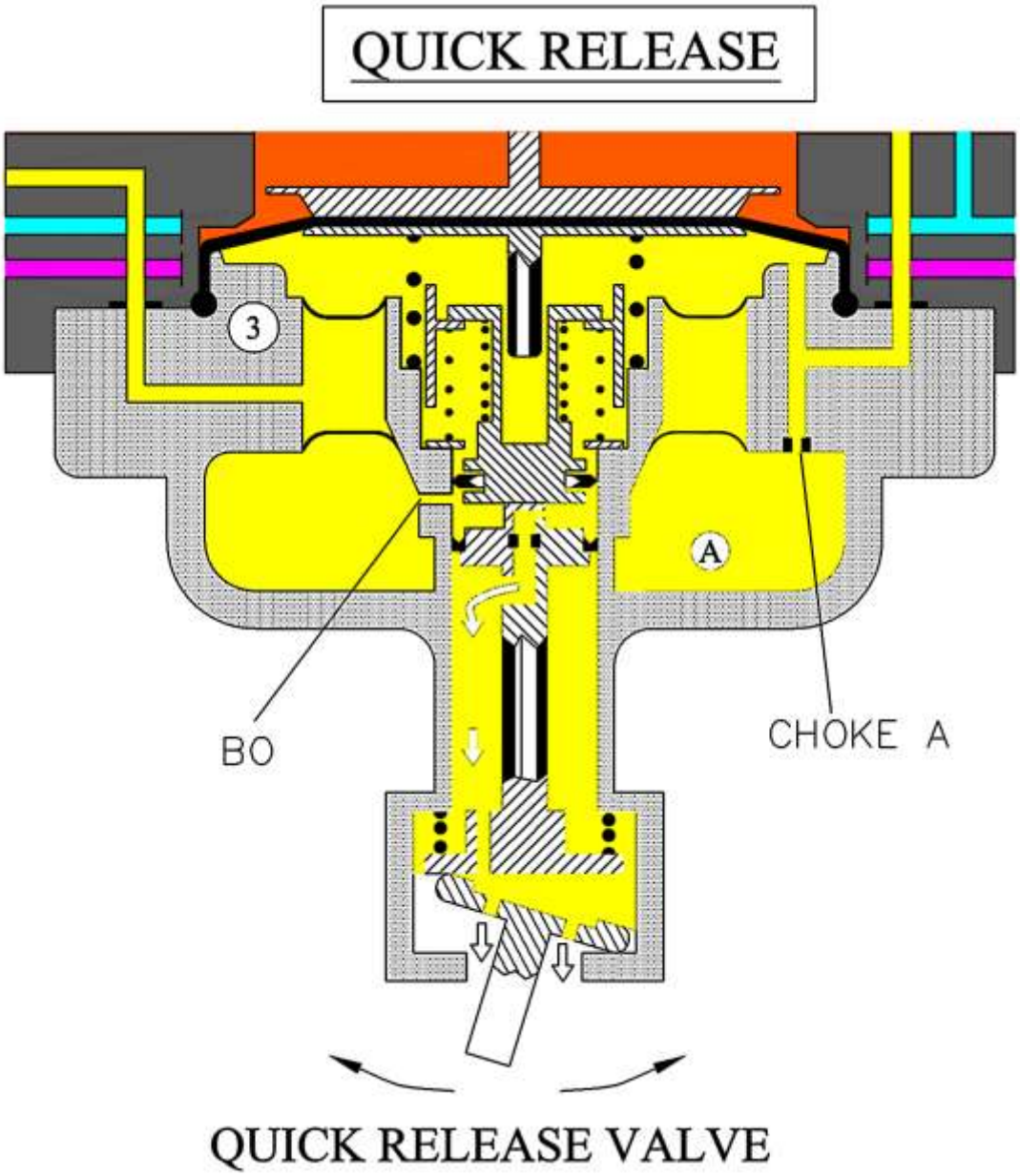


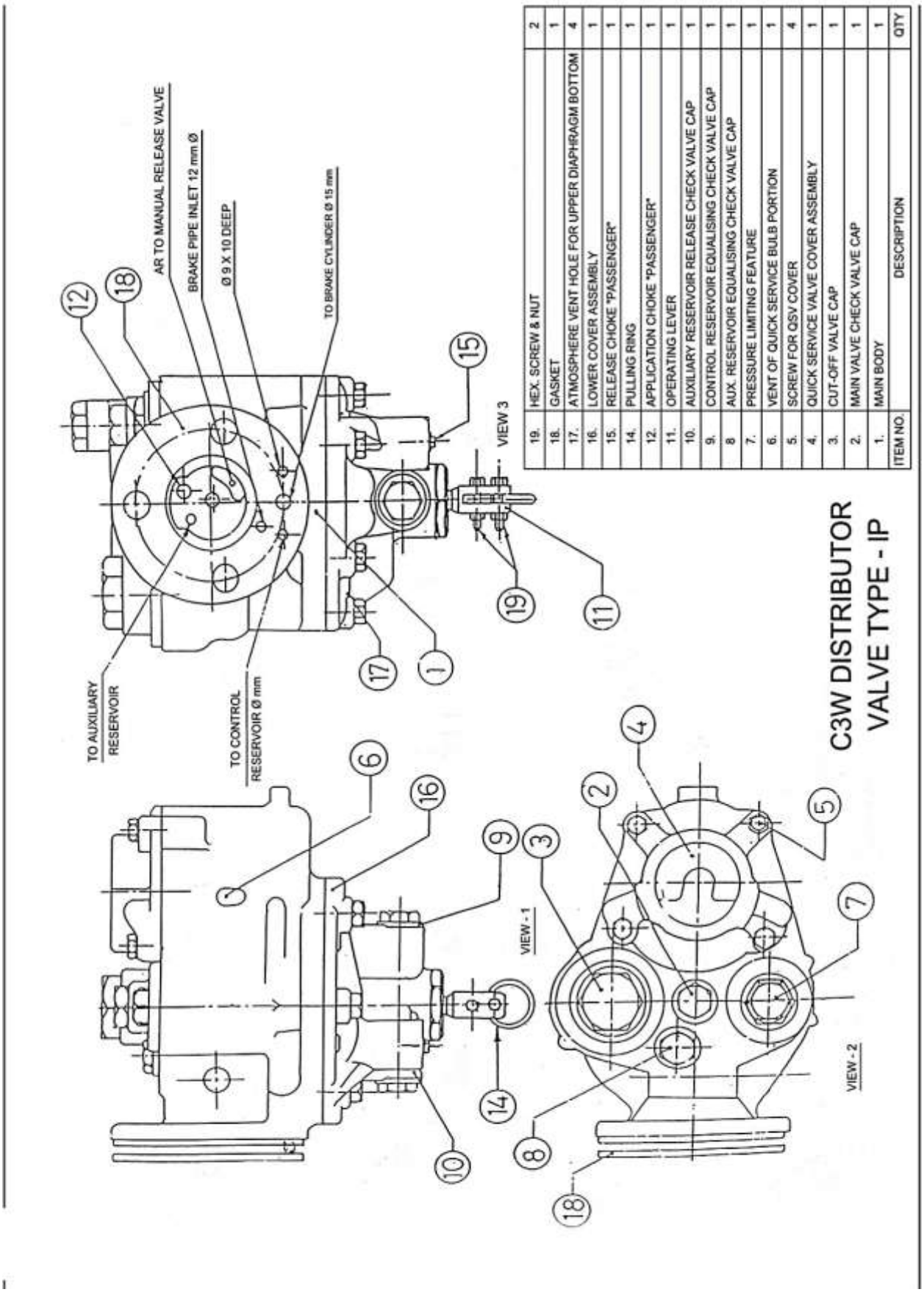
Figure: - 3.5

B. DISTRIBUTOR VALVE (FTIL Make)

1.0 INTRODUCTION

An UIC approved Distributor Valve type C3W IP is designed to work in conjunction with a Timing Volume and 1:1 Relay. **The existing standard Passenger Coach DV type C3W lP cannot work with the Relay and Timing Volume and hence, it can not be used with the Relay.** To prevent usage of the standard DVs in the Brake Frame, a Dowel Pin is provided on the Integral Volume Sandwich Piece, which will be received by a corresponding hole in the DV Flange. The DV functions to supply or exhaust the Brake Cylinder control pressure to the Relay in response to the changes in the regime Brake Pipe pressure towards decrease or increase respectively. When the regime pressure is restored and maintained at 5 ksc, it withdraws the Brake Cylinder control pressure from the Relay to atmosphere and initiates the brake release. The Distributor Valve gives a maximum BC pressure of 3.8 ksc during full service or emergency application of Driver‟s Brake Valve when the Brake Pipe regime pressure is set at 5 ksc. It incorporates a pressure limiting feature to ensure the control BC pressure is not exceeded beyond 3.8 ksc, even in circumstances of Brake Pipe / Control Reservoir getting overcharged due to any reason beyond 5.0 ksc. The DV together with the relay has application and release timings of a passenger brake system.

The following information is for combined assy of distributor valve with timing volume & also for individual assemblies.



ITEM NO.	DESCRIPTION	QTY
1.	MAIN BODY	1
2.	MAIN VALVE CHECK VALVE CAP	1
3.	CUT-OFF VALVE CAP	1
4.	QUICK SERVICE VALVE COVER ASSEMBLY	1
5.	SCREW FOR QSV COVER	4
6.	VENT OF QUICK SERVICE BULB PORTION	1
7.	PRESSURE LIMITING FEATURE	1
8	AUX. RESERVOIR EQUALISING CHECK VALVE CAP	1
9.	CONTROL RESERVOIR EQUALISING CHECK VALVE CAP	1
10.	AUXILIARY RESERVOIR RELEASE CHECK VALVE CAP	1
11.	OPERATING LEVER	1
12.	APPLICATION CHOKE "PASSENGER"	1
14.	PULLING RING	1
15.	RELEASE CHOKE "PASSENGER"	1
16.	LOWER COVER ASSEMBLY	1
17.	ATMOSPHERE VENT HOLE FOR UPPER DIAPHRAGM BOTTOM	4
18.	GASKET	1
19.	HEX. SCREW & NUT	2

2.0 GENERAL

This C3W Distributor Valve meets all the specifications laid down by UIC / RDSO and offers security, sensitivity and reliability for application to air brake system of LHB Coaches. The C3W Distributor Valve is of graduated release type.

3.0 MAIN CHARACTERISTICS

General Features of C3w Distributor Valve

- Compact and sturdy in construction.
- High Sensitivity
- Step less graduation in brake application and release
- High speed of propagation
- Maximum Brake Cylinder Pressure Limiting Device, independent of the BP regime pressure in case of Passenger Distributor Valve.
- Easy access to Chokes for cleaning and replacement.
- Confirms to UIC / RDSO specifications of graduated release Air brake system
- Suitable for both single pipe and twin pipe Air Brake System.

4.0 PERFORMANCE

The speed of propagation is in the order of 280 m / sec and is obtained by provision of a Quick Service Valve.

The brake is applied within 1.2 sec when Brake Pipe pressure drop is 0.6 bar in 6 secs (UIC No. 547).

The brake does not apply when Brake Pipe pressure drop is less than 0.3 bar in 60 secs. (UIC No. 547).

After full braking, Brake Pipe pressure can be increased to 6 bar with a view to obtain a faster brake release and a protective feature in Distributor Valve prevents the danger of overcharge of the Control Reservoirs from 5.0 Kg/cm2 to 6 bar for a period of 25 secs min.

Brake application and release graduations of 0.1 bar are possible.

If the Brake Pipe regime pressure is set at 5.0 Kg/cm2 , the Distributor Valve restricts Brake Cylinder pressure to 3.8 ± 0.1 bar max, irrespective of the drop in Brake Pipe pressure or the Auxiliary Reservoir air pressure (provided it is sufficiently at a higher pressure than 3.8 bar even after repeated brake application in a single pipe system). However, after a brake application is made, full brake release is not achievable till the Brake Pipe pressure builds up to 4.85 bar.

Provision is made for release of brake on the vehicle (manual release) when brakes are fully applied. This is especially useful in marshalling operation by venting Control Reservoir air pressure. It is also possible to vent all the brake equipment air pressure fully. To operate this feature, the handle of Isolating cock on Sandwich Piece is to be moved to the close position and the release lever of the Distributor valve pulled briefly.

CAUTION

1) Mere closing of Isolating Cock does not Release the brake in the vehicle.

2) For complete venting of the system including the Auxiliary Reservoir, the Release lever should be held in pulled condition till the air exhaust stops.

5.0 DESCRIPTION OF DISTRIBUTOR VALVE

The Distributor Valve has air pipe connections to
Brake pipe (BP)
Auxiliary Reservoir (AR)
Control Reservoir (CR)
Brake Cylinder (BC)

The Distributor valve consists of major sub assemblies housed in a Body with their functions as under:
Main Valve
Cut off valve
Quick Service Valve
Auxiliary Reservoir Check Valve
Inshot valve
Application and release chokes
Double release valve

5.1 MAIN VALVE

(Ref. Fig 4.1 and Fig 5.1)

The Main Valve provides feeding & exhaust of the Brake Cylinder according to the Brake Pipe pressure variations during operations. It consists of two Diaphragms 6 and 27, a Check Valve 37, two springs 7 & 39, static and Dynamic Seals. The Valve 37 is controlled by the movement of Hollow Stem 30, the top part of which forms the exhaust seat. The valve 37 and Hollow Stem 30 jointly control the connection between Auxiliary Reservoir and Brake Cylinder (for application) or between Brake Cylinder and Exhaust port (for release). The upper face of Diaphragm 27 (top) is exposed to Brake Cylinder pressure and the opposite side to atmosphere through a vent in body. The upper face of Diaphragm 6 is exposed to Brake Pipe pressure and the lower face to Control Reservoir pressure.

When compressed air at a regulated pressure charges through Brake Pipe into the Distributor Valve, it passes first into the Cut off Valve from which it is regulated to charge into the Control Reservoir and simultaneously the Auxiliary Reservoir. The Brake Pipe air also is charged into the connected internal chambers in the Distributor Valve. With the system fully charged, a balanced state is achieved with the main diaphragm assembly in release position and the Main Check Valve (37) in closed condition. Any reduction of pressure in the Brake Pipe during brake application causes a depletion of pressure on top of the Main Valve Large Diaphragm (6) which is moved up due to the reference pressure of Control Reservoir at a constant level of 5 Kg/cm2 acting underneath. This movement of the Diaphragm causes the Hollow Stem to lift the Main Check Valve and admit Auxiliary Reservoir pressure into the Brake Cylinders. The pressure in the Brake Cylinder increases in the ratio of areas of Diaphragms (27 & 6). Similarly, during brake release any pressure increase on the topside of the Large Diaphragm (6) results in a corresponding pressure reduction in the Brake Cylinder.

In order to limit the maximum Brake Cylinder pressure, the Large Diaphragm Follower is split into two parts and arranged concentrically, one as Large Piston (8) on top and the other a central Small Piston (10) overlapping one another. When a drop in Brake Pipe pressure is in excess of 1.5 Kg/cm2, the load on large piston (8) is cancelled due to physical obstruction of its collar with the Body. Only the Control Reservoir constant pressure acting on the Central Piston (10) forces against the Brake Cylinder pressure on the Diaphragm (27). With this a balance of Brake Cylinder pressure is then limited to 3.8 bar.

5.2 CUT OFF VALVE

(Ref. Fig 4. 1 and Fig 5.2)

The Cut Off Valve housed in body below cap connects the Brake Pipe air with Control Reservoir during charging through a Valve (68) fitted with calibrated choke Solex Jet (66) and this determines the charging time of Control Reservoir. It instantly “cuts off” this Control Reservoir pressure at the beginning of each brake application through a Valve (75) and restores the connection when brake release is nearing complete. The Cut Off Valve also controls the charging of compressed air into the Auxiliary Reservoir through Valve (71) which acting in conjunction with a seat formed in Plug (74) controls the charging of Auxiliary Reservoir.

The Cut Off Valve is principally composed of two Diaphragms (77) and (83) (Seal). The Seal (83) and Guide (86) (diaphragm and follower assembly) is subject to the Brake Cylinder pressure on the underside with its upper face being in communication to atmosphere. A Spring (85), which acts on Guide (86) (Follower) makes this to open Valve (75) by means of Push Rod (79).

The upper face of Diaphragm (77) with Follower (76) is subjected to Control Reservoir pressure and lower face to Brake Pipe. Thus Auxiliary Reservoir initial charging from Brake Pipe is piloted by Control Reservoir charging. The Cut Off Valve assembly as can be seen from the Fig 4.1, is a “Floating Cut Off Valve” on Diaphragm (77), which is acted upon by Control Reservoir pressure on the topside and the Brake Pipe pressure at the bottom. When a Brake Pipe pressure drop at the rate of 0.6 bar in 6 secs is made, the

pressure of air under the Diaphragm (77) depletes at a much faster rate than the rate of flow of Control Reservoir air from the top face of the Diaphragm. This sudden pressure differential across the face of the Diaphragm (77) causes the Floating Cut Off Valve assembly to move down instantly loosing contact with Push Rod (79). Due to the sudden downward movement, the Cut Off Valve (75) is pushed up by Spring (73) to close on its Valve Seat separating the Control Reservoir side from the Brake Pipe.

Similarly, if the Brake Pipe pressure depletion is at a much lower rate of 0.4 bar in 60 secs, the Brake Pipe pressure as well as the Control Reservoir pressure deplete together at a same rate keeping the Diaphragm (77) in a neutral position. Since there is a simultaneous drop of Control Reservoir pressure, no brake application will take place during such "insensitivity drop".

5.3 QUICK SERVICE VALVE

(Ref. Fig 4.1 and Fig 5.3)

Quick service portion contains the bulb capacity and is closed by Cover Assembly (40). It facilitates to vent a determined volume of air of Brake Pipe pressure into the built-in-chamber (Bulb), whenever brake application is initiated and thus causes "a local sudden pressure depletion in the Distributor Valve". This local pressure depletion is picked up by the next Distributor Valve in the vicinity in which also such similar local pressure depletion will be caused because of Brake Pipe pressure charging into the Quick Service Bulb. In this fashion, the initial depletion of pressure in the Brake Pipe is relayed from valve to valve in a train formation to propagate the signal of Brake Pipe pressure depletion. As could be seen, this Quick Service function is only for the initial Brake Pipe pressure depletion and is not for successive progressive Brake Cylinder pressure build up. The chamber (Bulb) is exhausted to atmosphere when the Brake Cylinder pressure drops
near to 0.8 bar during brake release, to prepare the Distributor Valve for subsequent brake applications.

The Quick Service Valve basically consists of: (Fig 5.3)

- A Large Diaphragm (214) and Diaphragm Clamp (215) Assembly, whose upper surface is subjected to Control Reservoir pressure and the underside to Brake Pipe pressure.
- A Lip Seal (208) (Diaphragm) and a Washer (Follower) Assembly (209), whose faces are subjected during service condition to atmospheric pressure on the upper face and Brake Pipe pressure or Quick Service Bulb pressure on lower face.
- A Valve (204) fitted in Seat Holder and Seat Assembly (206) operates in conjunction with seats formed on the Seal Holder (212) and end of Guide Plunger (219). When operated by Guide Plunger (219), it facilitates to connect the Quick Service Bulb to Brake Pipe during brake application or to isolate it during release. The lower part of the Guide Plunger forms the vent port through which the bulb air is vented to atmosphere.
- A Valve Assembly (59) that prevents premature venting of the Quick Service Bulb to atmosphere during release as long as a certain amount of Brake Cylinder pressure is acting on it.

5.4 DOUBLE RELEASE VALVE

(Ref. Fig 4.1 and Fig. 5.1)

The Double Release Valve provides a manual release of brakes and is contained in the lower cover assembly. The valve by a single movement of operating lever with pull of the ring causes:

- Elimination of overcharge in the Control Reservoir on a vehicle whose brake is applied.
- Brake release when Brake Pipe is vented by exhausting the Control Reservoir.
- By continuous action of pulling the ring on the Operating Lever, complete venting of all brake equipment and system.

It consists basically of:

- Two Valves with Seals (11) & (18) which are held together against their seats by Springs (19). These valves isolate the Control and Auxiliary Reservoir from atmosphere.
- An Operating Lever which when operated lifts the spring seat and valve operator (pivot piece). This in turn tips open and vents to atmosphere the Control Reservoir pressure first through Valve (11) and then through Valve (18) Auxiliary Reservoir pressure, if the displacement continues.

The release device is located in Bottom Cover and consists of:

- A locking rod maintains the Valve (11) (Control Reservoir) in open position and prevents re-closing after a single action on operating lever i.e. if a manual release is carried out when the Brake Pipe pressure is lower than that in the Control Reservoir. When the Brake Pipe pressure is higher than the Control Reservoir pressure, a Ring (23) (under Diaphragm Follower) is moved downwards by Lower Diaphragm (6) and causes a trigger 2C (Fig. 5.1) to raise Latching Stem (2D). This releases Valve (11) (Control Reservoir) and allows it to re-close.

5.5 AUXILIARY RESERVOIR CHECK VALVE

(Ref. Fig 4.1 & Fig 5.3)

This Check Valve permits recharge of Auxiliary Reservoir and prevents any flow back towards the Brake Pipe during brake application. The Cap (44) is provided with an „O" Ring (99) as a sealing joint between Body and Cap.

5.6 PRESSURE LIMITING FEATURE

(Ref. fig 4.2 and fig 5.4)

A separate attachment is provided on top of Inshot Valve to limit the Brake Cylinder pressure not to exceed beyond 3.8 bar, under any circumstances even if the Control Reservoirs are overcharged due to any reason above 5.0 bar. The arrangement is indicated in the sketch. The Spring (712) is adjusted to regulate the Brake Cylinder pressure to 3.8 bar during DV testing. The Pressure Limiting feature is controlled by Spring (712) which constantly exerts pressure on Guide (711) downwards. Due to this, the Valve Finished (223) and Spring (709) is continuously kept pressed down in the open condition. As and when BP reduction

takes place, Main Valve is lifted allowing Auxiliary Reservoir pressure to enter the Inshot passage and passes through opening made by Valve Finished. The Auxiliary Reservoir air pressure further passes into the Brake Cylinder through the opening of Cup (710) into the bottom of Diaphragm (77). As the pressure increases under the Diaphragm, the Spring (712) assumes a position to close Valve Finished (223) on the Seat by the Spring (709), thereby cutting off the further air supply. With this feature, any pressure from Auxiliary Reservoir above 3.8 not allowed in the Brake Cylinder area.

6.0 OPERATION

(Ref. Fig. 4.2)

6.1 CHARGING AND RUNNING

Compressed air at 5.0 Kg/cm2 from Brake Pipe enters the following regions of Distributor Valve colored blue:

Chamber 2, the top side of Lower Large Diaphragm of Main Valve.

Chamber 7 of Cut Off Valve

Chamber 4, the lower side of the Upper Diaphragm of QSV (Quick Service Valve)

Chamber D, chamber below the inlet valve of QSV

Further, the air from chamber 7 of cut off valve charges through the Solex jet and valve (6) to fill the following regions coloured Yellow:

Chamber 1, the bottom side of Lower Large Diaphragm of Main Valve. The top side of the Lower Diaphragm of Cut Off Valve.

Chamber 3, the top side of the Upper Diaphragm side of QSV.

Control reservoir (CR)

In addition, the air from chamber 7 lift the Check Valve (15) to fill the Auxiliary Reservoir, coloured Red. All the chambers mentioned above are brought to the charging pressure of 5.0 Kg/cm2 . Due to the “zero pressure” differential across the Large Diaphragm of the Main Valve when Control Reservoir is fully charged, the Diaphragm Assembly will be in neutral position. This keeps the central passage of the Main Valve Stem (Hollow Stem 30) that leads to atmosphere, open to Brake Cylinder, as a gap by design will prevail between Main Valve Check Valve (37) and Hollow Stem end at top.

6.2 GRADUATED APPLICATION

When a reduction in BP pressure is caused by the Driver‟s Brake Valve, the air pressure under the Diaphragm in chamber 5 of Cut Off Valve drops quickly. This makes the Diaphragm to flex down and closes the passage to the Control Reservoir, thus isolating it from BP. Due to the isolation of Control Reservoir in chambers 1 & 2 of Main Valve portion, a pressure difference is set across the Bottom Diaphragm (6) separating these two chambers causing a lift of the Hollow

Stem to open the Inlet Valve (Main Check Valve). Then, air from Auxiliary Reservoir will flow into chamber 9 from where it is led into chambers 11 (Cut Off Valve portion) and 16 (QSV portion) and also to the bottom side of Inshot Valve. In chamber 11, the air pressure builds up under Diaphragm and lifts up, thereby withdrawing the Pin from Valve (6). In In shot Valve, air passes through the valve opening and also through "Application Choke" into Brake Cylinder.

This sudden rush of air into the Brake Cylinder will help to bring the brake rigging / shoes quickly to position. Air also enters chamber 10 and lifts the Diaphragm of Inshot Valve and closes the valve passage. A pressure of about 0.5 ± 0.2 bar is enough to close the Inshot Valve passage. Once this passage is closed, air flows only through the Application Choke into the Brake Cylinder. In chamber 8 on top of the Upper Diaphragm of the Main Valve, the Brake Cylinder pressure builds up bringing the Diaphragm Assembly downwards and finally bringing the Inlet Check Valve to lap position. As soon as the balance is reached in this Diaphragm Assembly, no more air can flow into Brake Cylinder. Similarly, every time the Brake Pipe pressure is reduced in steps, the phenomenon will repeat and air from Auxiliary Reservoir will gradually flow into Brake Cylinder in corresponding steps. In case of full service application OR an emergency application, the maximum Brake Cylinder pressure that is required to balance the main valve diaphragm assembly is 3.8 ± 0.1 bar with Brake Pipe regime pressure set at 5.0 Kg/cm2 .

6.3 QUICK SERVICE APPLICATION

As soon as the Brake Pipe pressure is reduced, the pressure in chamber 4 under the Quick Service Bulb (QSB) Upper Diaphragm is reduced, causing the diaphragm assembly of the bulb to move down to open Inlet Valve (13). Then air enters bulb 12 and builds up pressure under the Seal in chamber 17, developing an upward force on the Diaphragm Assembly. This sudden surge and filling up of a large volume of air into the additional space causes local pressure depression of about 0.4 bar in chamber 2 of the Main Valve, help in the quick propagation of the Brake Pipe pressure reduction through the length of train. The bulb is exhausted once the Brake Cylinder pressure reaches around 0.8 bar during the brake release operation. This facilitates quick service propagation should an application be made immediately.

6.4 GRADUATED RELEASE

When the pressure in Brake Pipe is increased, the balance in the Diaphragm Assembly in the Main Valve is upset due the pressure rise in chamber 2, causing the Piston Assembly to move downwards and thus opening the exhaust passage. Air from Brake Cylinder is released through passage of Hollow Stem and finally is let off to atmosphere through the "Release Choke" located inside Exhaust Protector.

6.5 OVERCHARGE PROTECTION

Pressure in chamber 11 of the Cut Off Valve under the Seal causes the guide to lift up, making the pin free. The guide will not come down till the Brake Cylinder pressure reaches as low a value as 0.2 bar and till such time the Valve (6) would be kept closed isolating Control Reservoir and eliminating overcharge into Control Reservoir.

6.6 AUTOMATIC RELEASE

When the Operating Lever is pulled briefly, the locking rod slides down and gets wedged in between Double Release Valve and its Seat, thereby facilitating draining of Control Reservoir air from chamber 1 and also all the connected chambers. This upsets the balance of the Diaphragm Assembly and opens the exhaust passage. Air pressure from Brake Cylinder and chamber 8 (upper portion of Top Diaphragm) is reduced till a new balance is achieved, thus facilitating a partial brake release. If the Operating Lever is pulled for a long time, the Double Release Valve in the Lower Cover will be moved off from their seats permitting complete draining of the entire system.

FIG 4.1 – CHARGING AND NORMAL RUNNING CONDITION

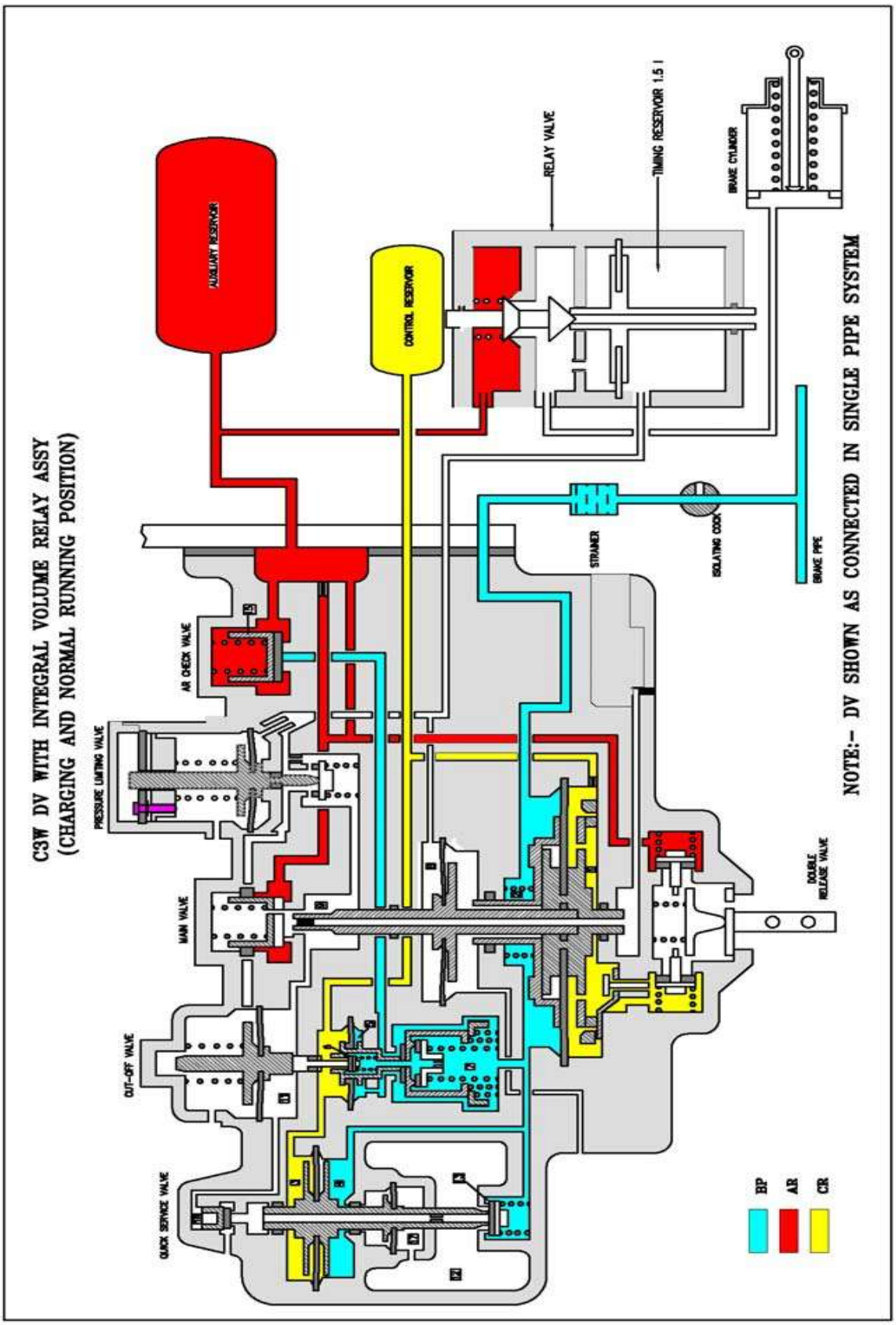


FIG 4.2 – GRADUATED APPLICATION

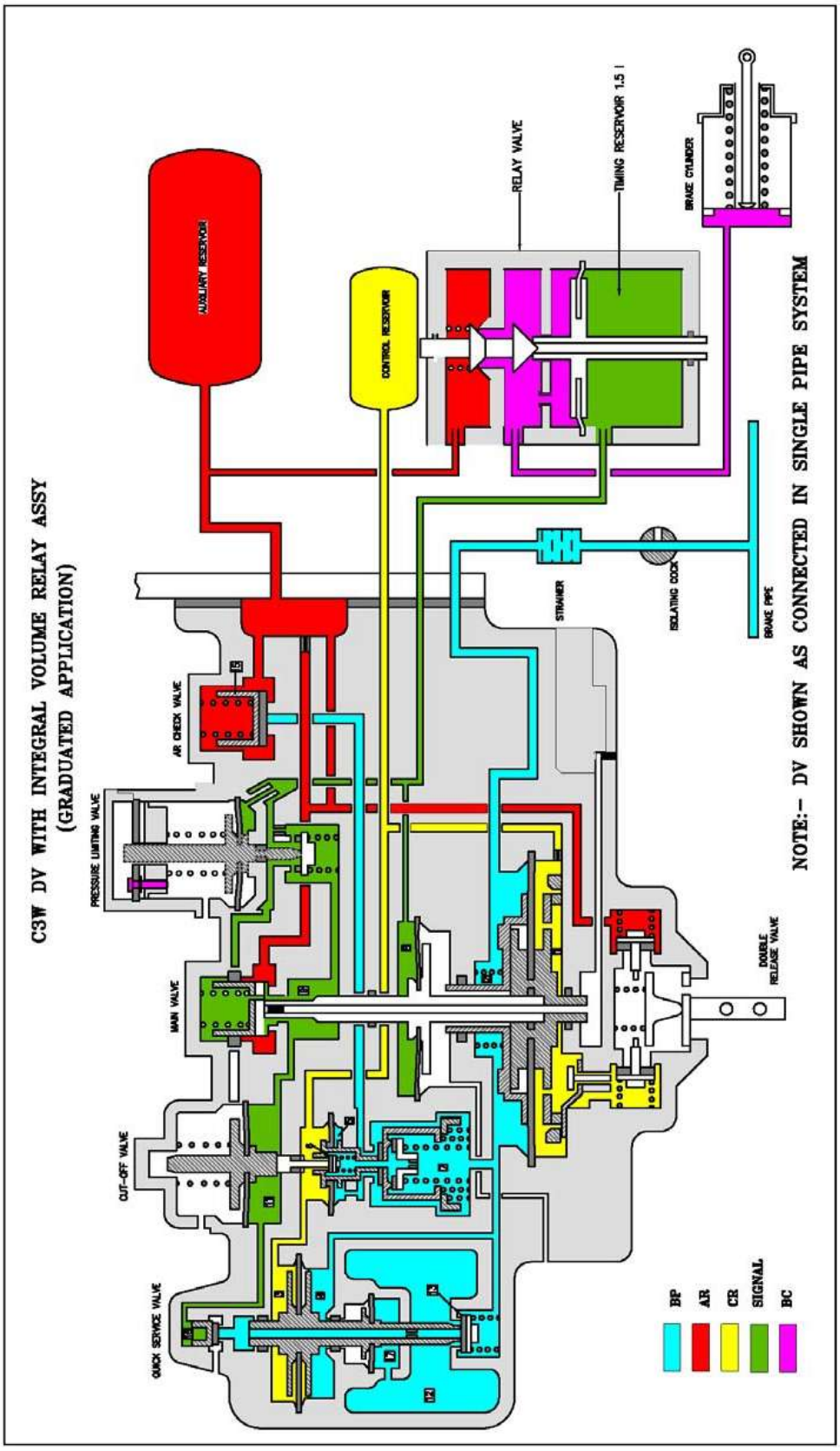


FIG 4.3 – GRADUATED RELEASE

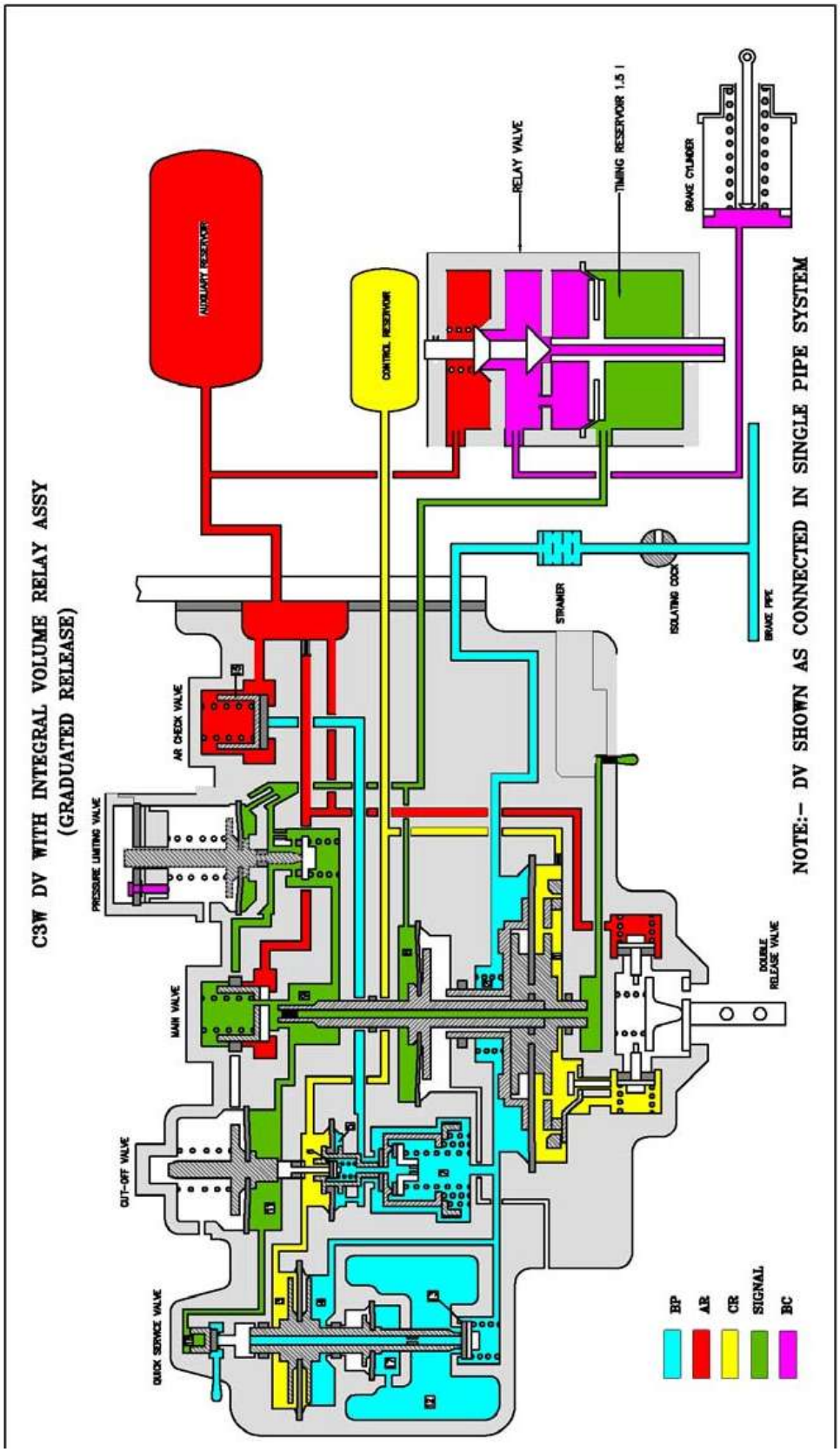


FIG 5.1 MAIN VALVE

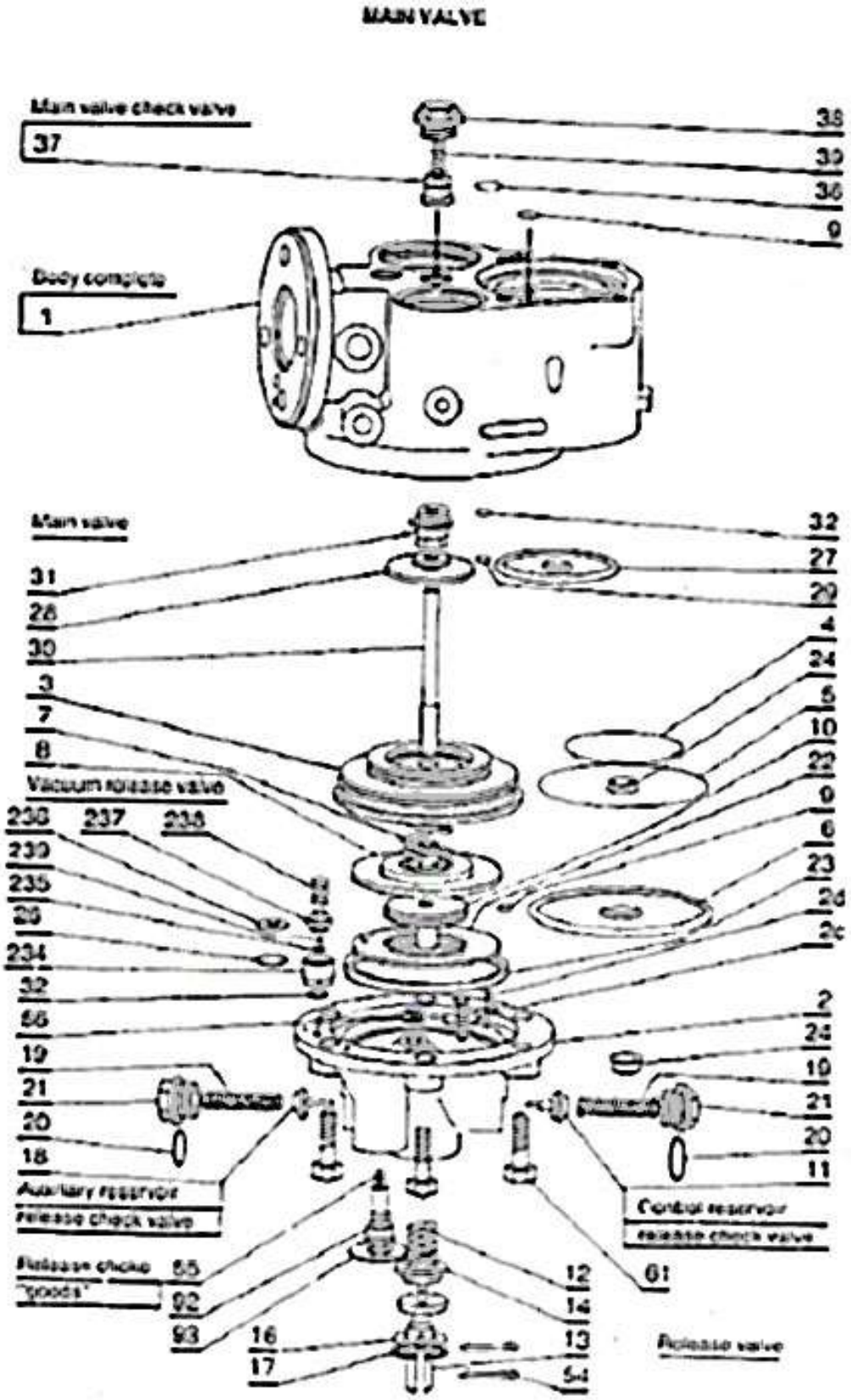


FIG 5.2 CUT OFF VALVE

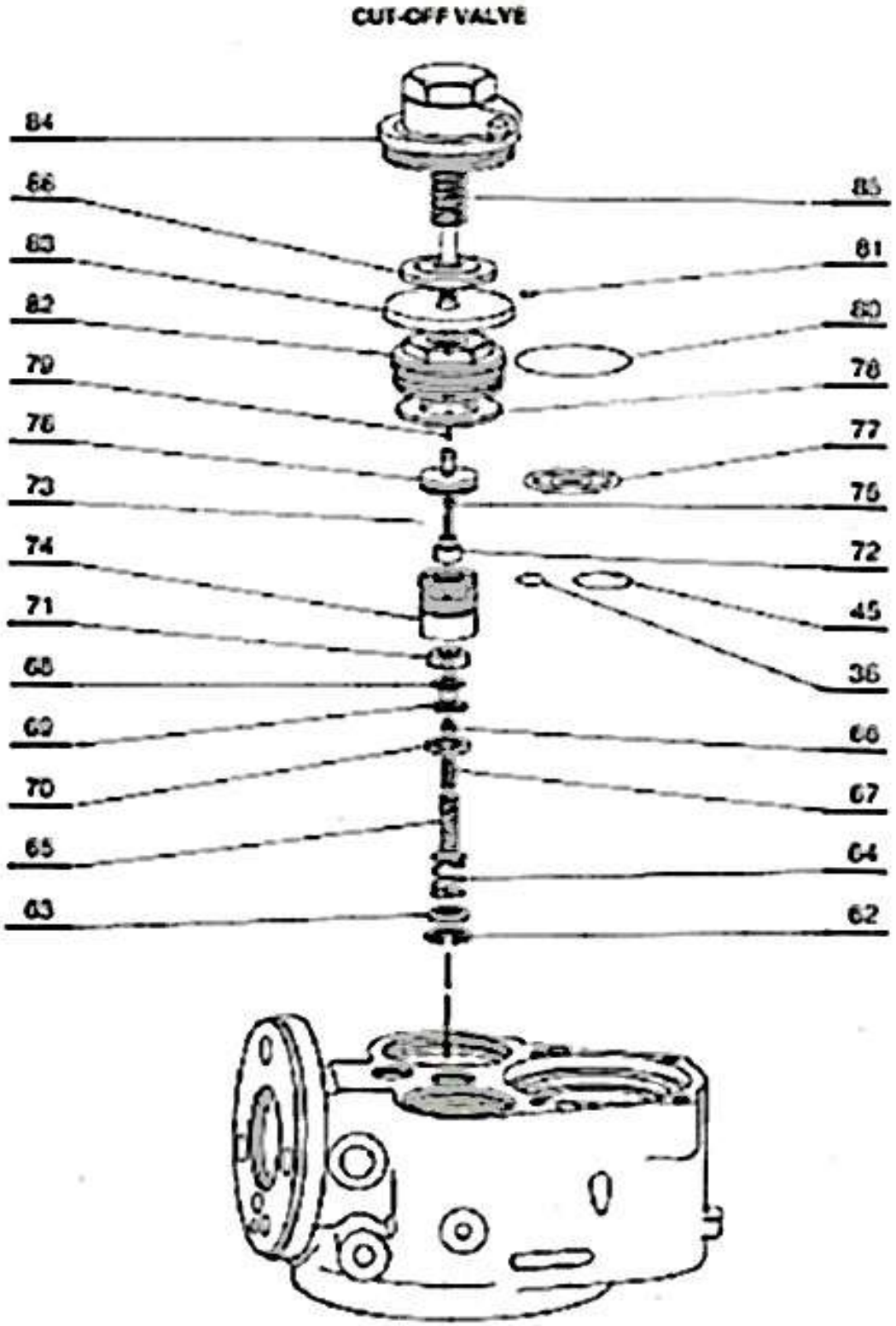


FIG 5.3 QUICK SERVICE VALVE

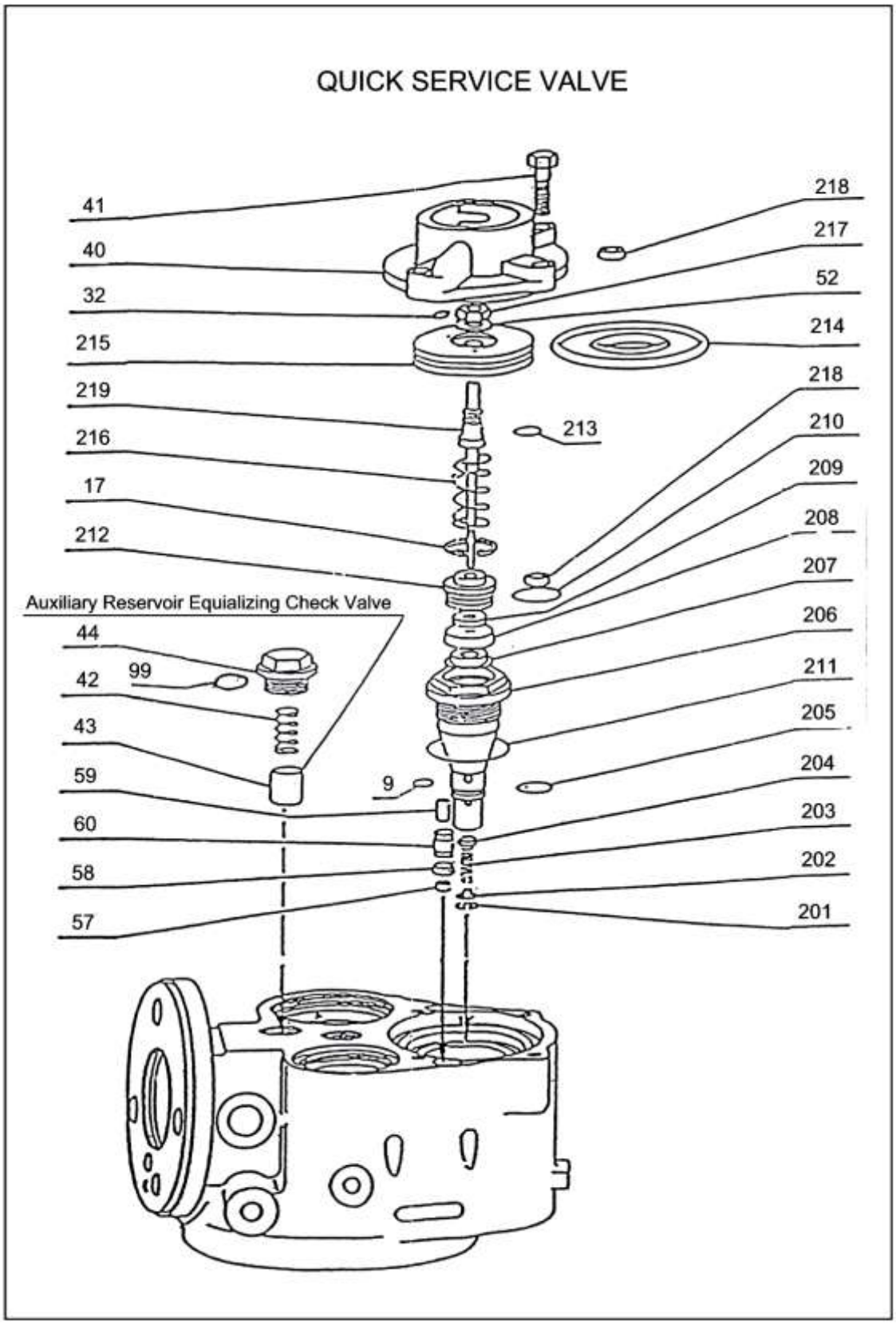


FIG 5.4 PRESSURE LIMITING FEATURE

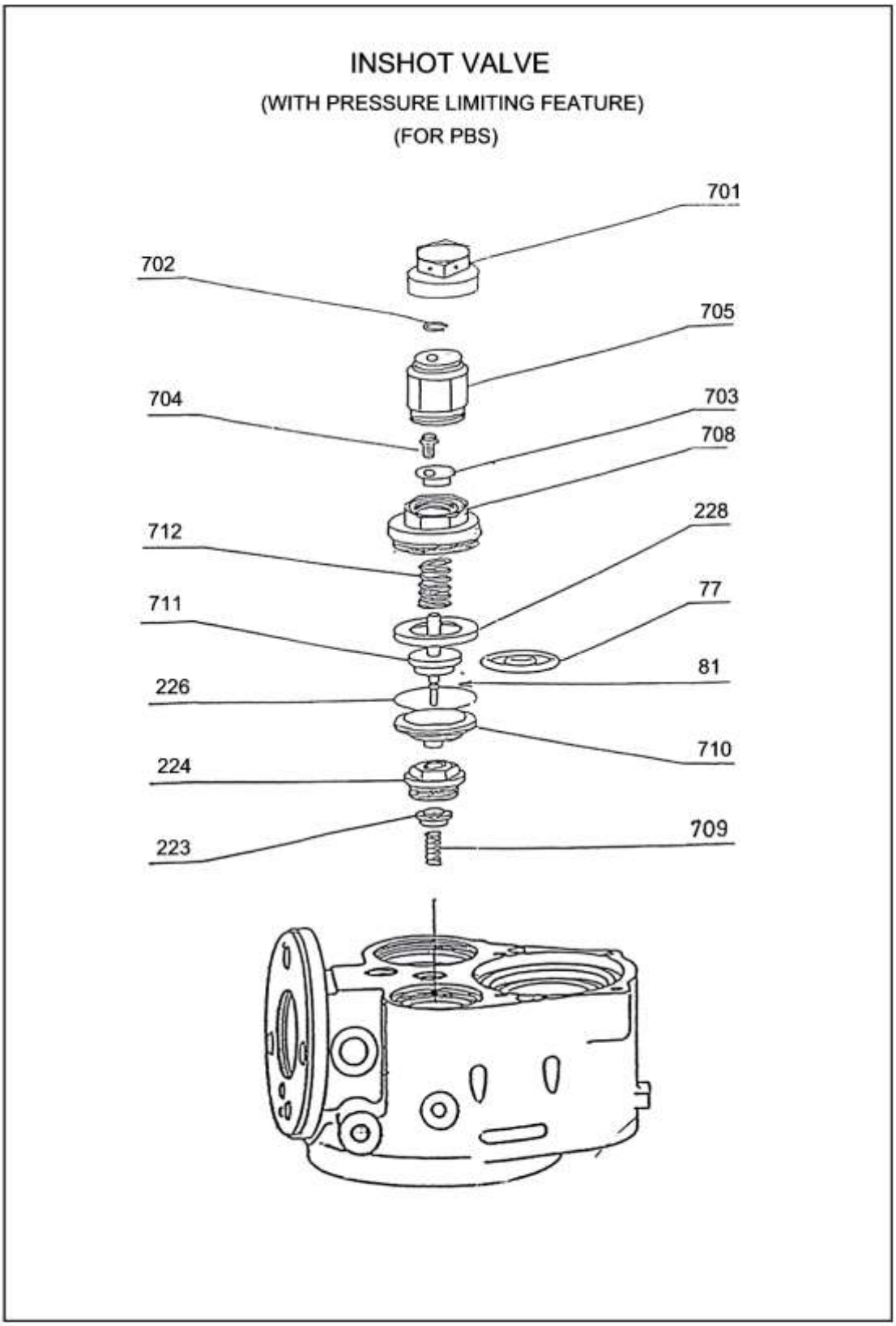
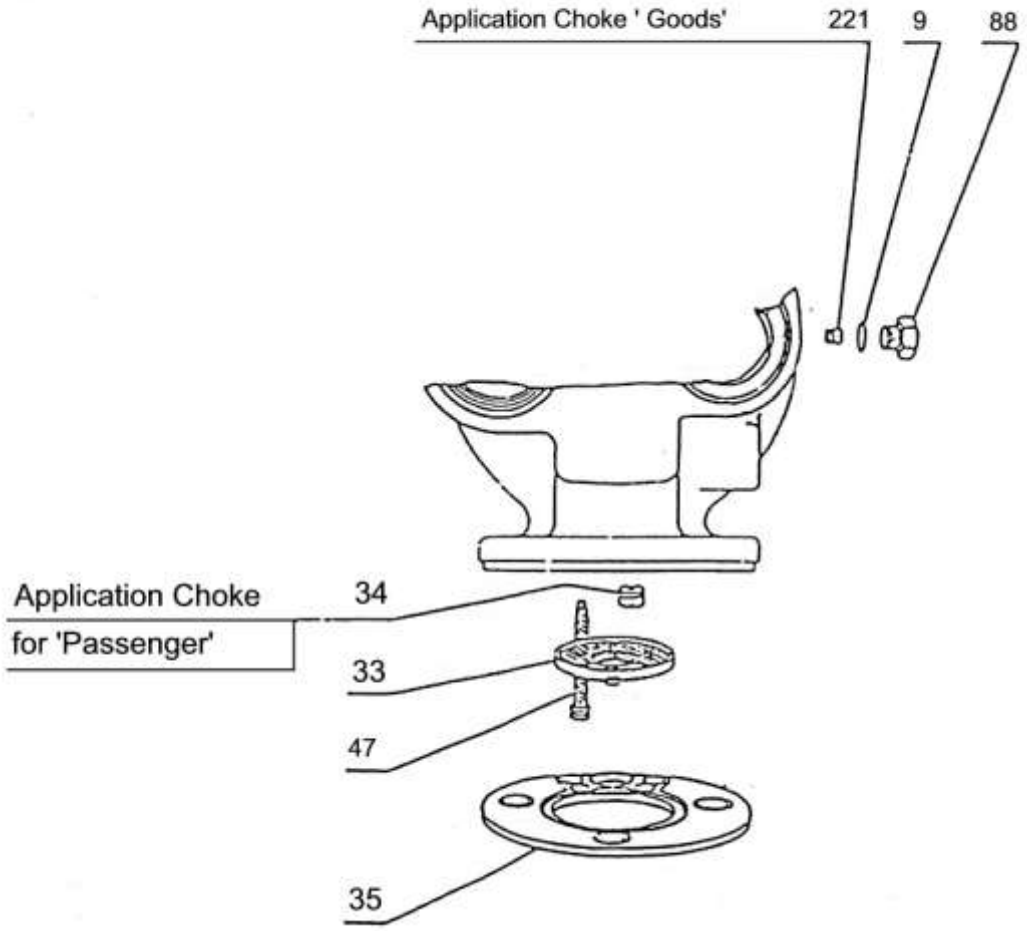


FIG 5.5 APPLICATION CHOKES



7.0 OVERHAULING

7.1 RECOMMENDED OVERHAUL RUBBER KIT TO FTIL PART No. 790 0402 80 FOR C3W DV – 501 0040 00

SN	Item No	WABTEC Cat No.	FTIL Part No.	Description	Quantity					
					Main Valve	Double Release valve	Cut Off Valve	Quick Service Valve	AR Equalising Check Valve	Inshot Valve
1	4	705 132	501 7010 00	O Ring	1					
2	5	705 134	501 7020 00	O Ring	1					
3	6	191 858	501 7030 00	Diaphragm	1					
4	9	705 012	501 7040 00	O Ring	2			1		1
5	11	191 874	501 8040 00	Valve Finished		1				
6	18	191 873	501 8090 00	Valve Finished		1				
7	20	191 879	501 7050 00	Sealing Washer		2				
8	24	705 818	501 7060 00	Lip Seal	2					
9	27	191 849	501 7070 00	Diaphragm	1					
10	29	705 011	501 7080 00	O Ring	1					
11	32	705 239	501 7090 00	O Ring	5			1		
12	33	191 840	501 602000	Filter						1
13	35	-	501 7101 00	Joint						1
14	36	705 249	501 7110 00	O Ring	1		1			
15	37	190 220	501 4060 00	Valve Finished	1					
16	43	190 115	501 4080 00	Valve Finished					1	
17	45	705 255	501 7120 00	O Ring			1			
18	47	787 686	501 6030 00	Filter						1
19	57	191 920	501 7140 00	Sealing Ring				1		

SN	Item No	WABTEC Cat No.	FTIL Part No.	Description	Quantity					
					Main Valve	Double Release valve	Cut Off Valve	Quick Service Valve	AR Equalising Check Valve	Inshot Valve
20	58	191 921	501 7150 00	Sealing Ring				1		
21	59	191 923	501 8180 00	Valve Finished				1		
22	68	189 888	501 4130 00	Valve Finished			1			
23	71	189 887	501 4160 00	Valve Finished			1			
24	75	191 942	501 4190 00	Valve Finished			1			
25	77	183 019	501 7160 00	Diaphragm			1			1
26	80	705 215	501 7170 00	O Ring			1			
27	81	705 212	501 7180 00	O Ring			1			1
28	83	191 964	501 7190 00	Seal			1			
29	99	704 819	501 7330 00	O Ring	1				1	
30	204	191 917	501 4220 00	Valve Finished				1		
31	205	705 091	501 7210 00	O Ring				1		
32	208	191 914	501 7220 00	Seal				1		
33	210	705 164	501 7230 00	O Ring				1		
34	211	705 128	501 7240 00	O Ring				1		
35	213	700 378	501 7250 00	O Ring				1		
36	214	191 894	501 7260 00	Diaphragm				1		
37	218	705 817	501 7270 00	Seal				2		
38	223	190 116	501 4260 00	Valve Finished						1
39	226	705 252	501 7280 00	O Ring						1

7.2 OVERHAUL SPRING KIT FOR C3W DISTRIBUTOR VALVE

SN	Item No	WABTEC Cat No.	FTIL Part No.	Description	Quantity						
					Main Valve	Double Release valve	Cut Off Valve	Quick Service Valve	AR Equalising Check Valve	Inshot Valve	Pressure Limiting Features
SPRING KIT No. 790 5011 07 FOR C3W DISTRIBUTOR VALVE											
1	7	191 870	501 8030 00	Spring	1						
2	12	191 881	501 8050 00	Spring		1					
3	19	191 882	501 8100 00	Spring		2					
4	39	189 931	501 8130 00	Spring	1						
5	42	191 968	501 8140 00	Spring					1		
6	64	191 990	501 8190 00	Spring			1				
7	65	191 856	501 8200 00	Spring			1				
8	67	182 714	501 8210 00	Spring			1				
9	73	190 272	501 8220 00	Spring			1				
10	85	789 650	501 8240 00	Spring			1				
11	203	191 918	501 8320 00	Spring				1			
12	216	191 922	501 8270 00	Spring				1			
13	709	-	501 8370 00	Spring							1
14	712	-	501 8590 00	Spring							1

7.3 DISMANTLING FROM COACH

Before dismantling the distributor from the coach for overhauling, ensure that the compressed air in the system is drained completely by pulling the operating lever and holding it in position till all the air pressure is fully exhausted.

NOTE:

Since the draining of air supply from the vehicle would release the brakes fully, care should be taken to protect the vehicle and prevent its accidental movement by suitable means.

Remove the DV along with its sandwich piece, relay valve & Timing reservoir.

Carefully supporting the Distributor Valve, unscrew the three M16 Nuts fixing the DV to its sandwich piece.

For further work on the Distributor Valve in the workshop, it is recommended to have a bench mounted clamp bracket with three Studs of M16 threads, fixed in the same fashion. Make sure that the fixture has a corresponding hole to accommodate the pin driven in the flange face of the DV. It should also have a facility to rotate by 180° and be locked in either position. (Refer fig. 7). The pipe connections to and from the mounting bracket on the vehicle need not be disturbed. However, it should be protected by a suitable covering to prevent ingress of dirt and dust till the Distributor Valve is reinstalled.

NOTE

Before the DV is opened, it should be thoroughly dusted and cleaned externally. The workbench on which the components are to be placed should also be cleaned thoroughly.

7.4 DISMANTLING THE DISTRIBUTOR VALVE

- Mount the Distributor Valve on to the Fixture (Fig 7) with the bottom side up.
- Follow the sequence of this operation as given below for dismantling.
- The item numbers in this description are with reference to the pull-out diagrams provided under the relevant heading.
- It is imperative that as and when the components are removed from the assembly, they have to be carefully handled and arranged, preferably in identifiable group sequence.

7.4.1 Main Valve

(Ref fig. 5.1)

Unscrew the 6 Nos. of Screws (61) & carefully pull upwards the Lower Cover Assembly (2).

Take out the Ring (23), the Diaphragm Follower (22) and the Small Piston of Lower Diaphragm (10) along with its Diaphragm (6), the Large Piston of Lower Diaphragm (8), and the five „O" Rings (32).

Press a jet of compressed air into the bore of the Hollow Stem (30) taking care to hold the Hollow Stem (30) the moment it ejects out under pressure. After removing the hollow stem (30), unscrew the release choke from the top opening of the hollow stem.

Remove the Diaphragm Holder (3) and pull out the Hollow Stem from Diaphragm Holder.

Take out the Diaphragm Clamp (28) with its Diaphragm (27).

Unscrew the Plug (31) using the appropriate socket wrench.

Turn the Distributor Valve by 180° on the bracket and ensure that it is again locked in the new position (bottom side down).

Unscrew the Cap (38) [with O‟ Ring (99) provided in the latest version] and take out the Spring (39) and Check Valve (37) with the „O‟ Ring (36).

Carefully remove the Diaphragm (6) from the small Piston of Lower Diaphragm (10) and Diaphragm (27) from the Diaphragm Clamp (28). Also remove the O Rings (4) and (5) from the Diaphragm Holder (3). Similarly remove the „O‟ Ring (36) from the Check Valve (37).

Using a blunt tool, remove the two Lip Seals (24) from the Diaphragm Holder (3) and from the Lower Cover (2). Similarly, remove the „O‟ Ring (9), „O‟ Ring (29) and the „O‟ Ring (32) from the small Piston of Lower Diaphragm (10), Diaphragm Clamp (28) and the Plug (31) respectively.

NOTE:

Care should be taken not to scratch the rubber components while removing. In case any such damage is suspected, replace such part by a new one.

7.4.2 Double Release Valve

(Ref fig. 5.1)

The Locking Rod (233) would have already come out when the Lower Cover (2) is pulled out. If not, remove it from the hole.

NOTE:

Do not try to remove the grooved Pin (2D) and Trigger (2C). These are permanently fixed in our factory and do not require any attention. While the cover is open, take care to see that no heavy object falls on the pin or on the Trigger.

Keep the flange face down on a soft surface like a rubber pad and press the Operating Lever (13) hard by hand and using the appropriate circlip plier, remove the Circlip (17). Remove the Lower Seat (16) and take over the Operating Lever. Take out the Spring Seats and Valve Operator (14) and the Spring (12).

Slowly unscrew the two Cap Screws (21) on either side and take out the two Springs (19). Take out the Sealing Rings (20) and pull out the Valves (11) and (18).

NOTE

Observe carefully the sides in which these Valves (11) and (18) are to be fixed while assembly.

Unscrew the Exhaust Protector (92) carefully and unscrew the Release Choke (55) from the Exhaust Protector (92) and take out the Exhaust Ring Protector (93).

7.4.3 Cut-Off Valve

(Ref fig. 5.2)

With the Distributor Valve mounted in its normal position, proceed as follows:

- Unscrew the bigger Cap (84) by using the appropriate socket wrench. Alternatively, a rod of suitable diameter that can go into the side hole on the cap can also be used.
- Carefully lift off the Cap (84) and remove the Spring (85), the Guide (86) and the Seal (83). If the Seal does not come out alone with the Guide and remain in stuck in position, use a bent tool and carefully lift it up. Rotating the tool all around, lift the seal uniformly and gradually from underneath. Ensure that the tool has no sharp edges.

NOTE

Ensure after removing the Seal that the two Springs in the Seal are properly seated in their position. The ends of the Springs are inserted into one another to form a ring of a specified diameter. Improper handling of the seal while pulling out may disturb the position of the Springs.

Remove the „O" rings (81) from the Guide (86) taking proper care.

Unscrew the Diaphragm Clamping Screw (82) using the appropriate socket wrench. Take out the Push Rod (79).

NOTE

The direction in which the push rod has to be inserted again during reassembly should be carefully noted down.

Holding the stem part of Guide (76), pull it out carefully so that the Diaphragm Clamp (78) also comes out. The Guide (76) is a sub-assy consisting of Seat (72) which is screwed into the Guide (76) Valve (75), Spring (73) & the Diaphragm (77).

Keep the sub-assembly in the special Fixture RPBF 0003 (Fig 6.3) in such a way that the flange part of the Guide (76) sits in the circular recess of the fixture and the Seat (72) is facing up. Keep the Fixture in a vice. Tighten the vice lightly. Using the special tool SCT6016 (Fig 6.3) unscrew the Seat (72) by inserting the two Pins of the tool into the two holes on the Seat (72) and turning the handle.

Take out Valve (75) and the Spring (73).

NOTE

While using the fixture RPBF 0003 (Fig 6.3), exercise care to avoid denting the flange of the Guide (76) due to over tightening of the vice. The Spring (73) and the Valve (75) are quite small in size and should be handled carefully.

Pull out Diaphragm (77).

Using special tool SCT 6014 (Fig 6.1) in the same way as for SCT 6016 (Fig 6.3), unscrew the Plug (74) and remove the outer „O" Ring (45) as well as the inner „O" Ring (36). The Plug is a sub-assembly consisting of an Internal Circlip (62), Spring Seats (63), (69) and (70), Spring (64) (65) and (67), a Solex Jet (66) and Valve Finished (68) and (71). Using a suitable circlip plier, remove the Circlip (62). Take out the Spring Seat (63) exercising caution in avoiding falling of loose components. Take out the Springs (64) (65) and (67). By pulling at Solex Jet (66), remove the Spring Seats (69) and (70).
Take out the Valve Finished (68) and (71). Unscrew the Solex Jet from the Valve (68).

7.4.4 Quick Service Valve

(Ref fig. 5.3)

With Clamp bracket in the same position as for Cut Off Valve, unscrew the four Screws (41).

Take the Cover Assembly (40) out, taking care to pull it up vertically.

Remove the „O" Ring (32) and „O" Ring (9) on the top surface of the Body.

Slowly pull out the Glide Plunger (219) sub-assembly consisting of parts (52), (213), (214), (215), (217) and (219) by pulling at the Guide Plunger top.

Remove the Spring (216).

Remove the Diaphragm (214) from the Piston (215) of the sub-assembly.

Holding the sub-assembly in hand, unscrew the Nut (217), remove the Washer (52) and pull out the Piston (215).

Remove the "O" Ring (213) without twisting it. Using the special tool SCT 6092 (Fig. 6.1) unscrew the Seat Holder (206).

Remove the "O" Rings (211) and (205).

Take out the Seat Holder Assembly (206) and using the appropriate circlip plier, remove the Internal Circlip (17). Pull out the Seal Holder (212) using the special tool SCT 6093 (Fig 6.2). Remove the "O" Ring (210)

Using a blunt tool, carefully pull out the seal (218) from the Seal Holder (212).

Remove the Washer (209). Carefully pull out the Seal (208) by using a bent tool and dragging up uniformly all round. Do not use any sharp hook to do this work.

Take out the Spring Seat (207).

Using the appropriate internal circlip plier, extract the Circlip (201) at the bottom of Seat Holder (206), taking care to prevent loose parts from inside falling off.

Remove the Spring Seat (202), Spring (203) and Valve Finished (204).

Using the same tool as was used for pulling out the Seal (218) from the Seal Holder (212), pull out the second Seal (218) from the Cover Assembly (40).

Take out the Bush (60) carefully by pressing a jet of compressed against the vent of quick service and the Valve Finished (59) from the hole in the top face of Body (1).

Extract the Seal (58) and the Sealing Ring (57) by carefully pressing on the Seal (58) on an edge to tilt it on Washer (57). Use only a blunt tool.

NOTE

While extracting the Seal (58) be careful not to damage it. However, as this cannot be pulled out in any other way than described above, if any damage to this component is suspected, make sure to replace it by a new one during reassembly.

7.4.5 Auxiliary Reservoir Valve

(Refer fig. 5.3)

With Body (1) in the normal position, unscrew the Cap (44) & O Ring (provided in latest version) slowly & take out the Check Valve Spring (42) & Check Valve (43).

7.4.6 Pressure Limiting Feature

(Ref. fig 5.4)

Open the Cap (701) remove Circlip (702), Stem Adjusting Screw (704) using special tool (Fig 12 A) and remove Spring Seat (703) from Clamping Flange (708).

Unscrew Clamping Flange and remove Spring (712) extract Diaphragm Clamp (228) and pull out Guide (711). Remove Diaphragm (77) from Guide (711). Remove O Ring (226) from its seating position on Cup (710) and remove the cup. Unscrew Plug (224) and remove Valve Finished (223) and extract the Spring (709).

7.4.7 Application And Release Chokes

(Ref fig. 5.5)

APPLICATION CHOKE

Remove from the side of Body the Application Choke (34) provided inside the Filter (32). The Filter has to be removed for renewal or cleaning of Choke.

RELEASE CHOKE

The Release Choke is provided in the hollow stem(30).

Choke description	FTIL PART NO
Application Passenger	501 4309 00
Release Passenger	011 3062 00

7.5 CLEANING OF PARTS

Refer guidelines given under "CLEANING PROCEDURE (AIR BRAKE EQUIPMENTS / COMPONENTS)"

REPLACE PARTS IF,

Refer the guidelines given under "INSPECTION / REPLACEMENT CRITERIA (AIR BRAKE EQUIPMENT / COMPONENTS)"

STEPS BEFORE REASSEMBLY

Smear carefully and lightly "MOLYKOTE M33" or equivalent grease to all

- Sliding parts
- Dynamic and static O rings and the parts on to which they slide.
- Diaphragms and seals
- Threaded parts except on the chokes and the Solex jet.

Smear carefully and lightly " Shell Rhodina RL3" grease or equivalent to all

- Threaded parts of chokes and Solex jet
- Bearings of all guides

7.6 ASSEMBLY

Follow the same instructions of each sub-assembly in the reverse sequence to assemble the valves. However, suggestions given as under while reassembly may be followed.

After mounting the Diaphragms on the Diaphragm Clamps, get the entrapped air out by inserting the special tool SCT 6026 (Fig 6.3) between the inside the Lip and the side of the Groove.

The elastomer surfaces of the valve must be free from grease.

Blow a jet of compressed on to the valve surfaces before assembling them into position.

Ensure that the tips of the screwdrivers, the circlip pliers and the other tools used are free from any sticky matter and are not carrying any dirt.

The „O‟ Ring (226) in the Inshot Valve Cup (225) is not mounted outside but is dropped into position after fixing the cup in its place with the help of a special tool SCT 6015 (Fig 6.1) suitably pushed uniformly into position. Keep the edge of the tool on the „O‟ Ring & rotate the tool with light pressure till „O‟ ring is seated properly without twist.

After assembling the parts (62) – (71) of the Cut Off Valve into the Plug (74), shake it lightly; a metallic sound should be heard. If not, extract the Circlip (62), remove the Spring Seat (63) and make sure that the Springs are correctly positioned. Also ensure a Spring Seats (69) and (70) are freely moving. Then reassemble the parts and repeat the operation.

To insert the Hollow Stem (30) through the Diaphragm Clamp (28), use the special feeding tool SCT 6017 (Fig 6.3) to avoid scratching of the „O‟ Ring (29) in the Diaphragm Clamp (28). This is done by the inserting tool into the Hollow Stem (30) on the side of the small diameter and pushing the tapered face of the tool into the Diaphragm Clamp slowly. Pull out the tool from the stem on the other side.

For the Inshot Valve portion, the Pressure Limiting arrangement consisting of items 701, 702, 703, 704 & 705 are also required to be assembled in the Inshot Valve portion.

NOTE

The limiting pressure is to be adjusted for a cut off pressure of 3.8 bar during DV test.

7.7 TIGHTENING TORQUE

TIGHTEN TO A TORQUE OF 20 – 25 Nm,

The Plug (74) and Seat (72) of the Cut Off Valve.

The Nut (217) of the Quick Service Valve Guide Plunger and Seat Holder (206) of the Quick Service Valve sub-assembly.

The Plug (31) in the Main Valve.

The Valve Seat (224) in the Inshot Valve and

The Caps (21) of the Double Release Valve.

After assembling the Double Release Valve in the Lower Cover (2), pull the Operating Lever (13) to the side in which the Trigger is pinned and press the Locking Rod (233) down, so that it gets jammed between the Valve Seat and the

Valve (11). Then even if the Operating Lever is released, the entire Lower Cover Sub-assembly (2) can be turned upside down to be mounted on Body (1) without the Locking Rod falling down. This Locking Rod gets released automatically once the DV is charged with air pressure to the required limits.

8.0 TESTING OF C3W DISTRIBUTOR VALVE AFTER OVERHAUL

After the Distributor Valve is overhauled thoroughly and assembled as described, fix the DV on the sandwich piece & attach the relay valve & timing volume as a unit assembly. Then it is to be mounted on to BRAKE PANEL MODULE (A0). Compressed air is to be charged at the specified pressure and Distributor Valve should be operated a few times, say 20 operations to execute a few applications and release cycles. Do not check for the leak tightness of the Distributor Valve during this cyclic operation.

After cycling, charge the Distributor Valve to 5.0 Kg/cm2 in a single pipe system and wait till the Auxiliary Reservoir and Control Reservoir also attain 5.0 Kg/cm2 .

At this stage, soap solution can be used to detect leak bubbles. If any leaks are observed, proper remedial action should be taken as per troubleshooting guide (attached) and Distributor Valve is to be rechecked for leak tightness and the performance. It is not required to check for leaks for duration of 5 minutes each. It is enough if a leak did not appear in one minute and even if it starts surfacing after a period of one minute, it can be considered as negligibly small and hence can be ignored.

NOTE :-

1. Distributor Valve (501 0040 00) alone cannot be tested as it is working along with the relay valve assembly (018 0040 00).
2. However the trouble shooting can be followed independently as provided under distributor valve & Relay valve.

8.1 FREQUENCY OF OVERHAULING

The Valve once put into field service needs no attention as long as the operating conditions and maintenance practices are as under are followed till its periodic overhaul.

“Reliable performance of C3W Distributor Valve is assured provided basic cleanliness inside the pipelines, reservoirs and at hose pipe ends is maintained and proper attention is given to air tightness, draining of reservoirs, filters, prevention of dust/dirt/moisture ingress.”

However, observation on Distributor Valves during Sick Line / workshop attention generally indicate substantial presence of some of the factors like moisture, dirt, water / oily sludge, corrosion rust, scales, etc, on the inside of BP/FP pipelines and brake system equipments. These are collected / formed over a period primarily due to non-supply of dry air / other operational reasons & may affect the performance parameters during operation. As such in order to ensure a sustained reliable performance, it is recommended to remove the Distributor Valve once in three years after the date of commissioning and coinciding the nearest POH towards performance test/examination and overhaul at a centralized workshop. In practice, it is enough to pay attention to the DV for any performance deviations noticed when the vehicle is serviced during the test in POH.

8.2 RECOMMENDED MAINTENANCE ATTENTION FOR DISTRIBUTOR VALVE

Refer as per OEMs Instruction

8.3 SPECIFIACTIONS OF GREASES TO BE USED

Refer as per OEMs Instruction

8.4 CONDITIONS FOR SAFE STORAGE OF RUBBER COMPONENTS SUCH AS 'O' RINGS, DIAPHRAGMS AND SEALS

Refer as per OEMs Instruction

8.5 TROUBLE- SHOOTING

Some of the distress symptoms / failures are given below for guidance duly indicating the possible sources of causes and contributory factors. The sequence of these failures and the possible sources are arranged in their decreasing order of probability of occurrence. However, while analyzing any such failure in the suggested sequential priority, the check need not be stopped at any particular cause of failure but better be continued to cover the other remaining causes that could also contribute to the same observation.

8.5.1 Control Reservoir Alone At 5.0 Kg/Cm^2

Operation Failure

Observations	*Causes of failure*	*Remedial Action*
Leak at Exhaust Ring Protector (93).	In the Main Valve Lip Seal (24) in the Lower Cover (2) is defective or fixed upside down.	Replace the Lip Seal (24) or assemble correctly.
Leak at Quick Release Chamber Outlet (F)	Lip Seal (218) in the Cover (40) of Quick Service Bulb defective or fixed upside down.	Replace or assemble correctly.
Leak back to the Brake Pipe, when the Brake Pipe pressure is reduced.	Surface condition of Valve (75) in the Cut-off valve defective.	Replace the valve
	Spring (73) wrapped.	Replace.
	Diaphragm (6 & 214) or Diaphragm (77) defective or wrongly assembled.	Replace or relocate
	„O" Ring (213) defective or twisted between 215 & 219.	d.Replace or relocate.
Leak at the Release Valve Lever (L)	Surface condition of Valve (11) defective in Double Release Valve (the one on the opposite side of the flange)	Replace the valve and attend.
Leak to atmosphere at the Hole (s) in the bottom cover, under Brake Cylinder reaction pressure.	Wrongly assembled diaphragm (6)	Relocate the diaphragm.
	„O" Ring (32) between body (1) and lower cover (2) defective	Replace „O" Ring
Leak to the Brake Cylinder.	„O" Rings (80) and (81) defective.	a. Replace.
External leakage between Lower Cover (2) and Body (1) or between Cover (40) and Body (1).	Diaphragm (6) or (214) wrongly assembled.	3.4 Relocate.
	„O" Rings (32) between lower Cover (2) and Body (1) defective.	b. Replace
External leakage to atmosphere from the Auxiliary Reservoir.	a. Sealing Ring (20) defective.	a. Replace.

8.5.2 Auxiliary Reservoir Alone At 5.0 Kg/Cm^2

Operation Failure

Observations	Causes of failure	Remedial Action
Leak back to Brake Pipe when the Brake Pipe pressure is decreased.	Surface condition of the Valve (43) defective.	Replace.
Leak at the Release Choke (Q)	Condition of Valve (37) defective.	Replace.
	„O‟ Ring (36) of Valve (37) twisted or defective.	Relocate or replace „O‟ Ring.
Leak to atmosphere at (S) under reaction to Brake Cylinder pressure.	„O‟ Ring (32) between Body (1) and Cover (2) defective.	a. Replace.
Leak at Release Valve (L) at the bottom.	Surface condition of Valve (18) defective.	Replace.
External Leakage	„O‟ Ring(s) (32) between Body (1) and Cover (2) and between Body (1) and top Cover (40) defective.	Replace.
	Metallic joints between Body (1) and Caps (38 & 40) defective.	Unscrew Caps and apply the Sealing grease and fix again.
	Sealing Ring (20) defective.	Replace

8.5.3 Brake Charging, Brake Pipe At 5 Bar
Operation Failure

Observations	Causes of failure	Remedial Action
Filling time of the Reservoirs too short.	Valve (71) does not close.	Reassemble the entire Cut off valve sub assembly (74)
	Springs (64,65 & 67) are wrapped or tangled up.	If wrapped, replace and reassemble properly.
	Spring Seats (69 & 70) jammed.	Replace if damaged and reassemble.
Vibrations while charging	„O‟ Ring (36 or 45) defective.	a. Replace.
Filling time of the Reservoirs too long.	The Solex Jet (66) is clogged partly.	Clean the orifice.

8.5.4 Brake Charged Brake Pipe At 5 Bar
Operation Failure

Observations	Causes of failure	Remedial Action
1. Leak at the Quick Release chamber outlet (F)	a. Surface condition of Valve (204) defective.	a. Replace.
	b. Seal (218) in Seal Holder (212) assembled upside down are defective.	b. Assemble properly or replace.
	c. „O‟ Ring (205, 210 & 211) are twisted or damaged.	c. Relocate or replace.
2. Leak to atmosphere under reaction of Brake Cylinder pressure at (S)	a. Seal (24) in Diaphragm Holder (3) wrongly positioned or defective.	a. Relocate or replace.
	b. „O‟ Ring (5) defective on Diaphragm Holder (3).	b. Replace.
	c. Diaphragm (6) wrongly assembled or defective.	c. Relocate or replace.

8.5.5 Insensitivity

Operation Failure

Observations	*Causes of failure*	*Remedial Action*
1. Brake Pipe pressure drop too slow, accompanied by drop in pressure in Auxiliary Reservoir.	a. Improper closing of Valve (43 or 75)	a. Check the surface condition and if required replace.
2. Brake Pipe pressure drop too quick.	a. Improper closing of the Quick Release bulb inlet Valve (204) thus allowing partial filling of the Quick Service Bulb.	a. Check the surface condition and if required replace.
3. Quick action in Brake Pipe while brake releasing.	a. Improper closing of valve (204).	a. Same as above.
	b. Valve (71) of Cutoff Valve does not open.	b. Same as above.
	c. Springs (64, 65 & 67) tangled up.	c. Assemble properly.

8.5.6 Sensitivity

Operation Failure

Observations	*Causes of failure*	*Remedial Action*
1. No quick action.	a. Valve (204) improperly functioning.	a. Check, relocate or replace.
	b. Valve (75) not closing properly due to defective surface of the defective spring (73)	b. Check, relocate or replace.
	c. Faulty assembly of quick service valve complete	c. Open fully (Quick service valve) and reassemble properly

8.5.7 Brake Application Step, Brake Pipe At 5 Bar

Operation Failure

Observations	*Causes of failure*	*Remedial Action*
1. Full brake application with large leak to atmosphere at (S) under pressure of brake cylinder.	a. Diaphragm (27) improperly assembled.	a. Reassemble.
2. Full brake application with no leak at (S).	a. Atmosphere leak hole at (S) clogged with dirt.	a. Open bottom Cover (2) and clean hole.

8.5.8 Brake Application Brake Pipe At '0' Pressure

Operation Failure

Observations	*Causes of failure*	*Remedial Action*
1. Application time less than 3 secs.	a. Leak around the threads of choke (221)	a. Unscrew (88) and (221) apply the sealing grease and retighten.
	b. Improper closing of valve (223) or delayed closing.	b. Check valve surface condition. If defective replace.
	c. Leak at metallic joints of Plug (31 & 224).	c. Unscrew and apply sealing grease. Retighten properly.
	d. „O" Ring (32) of Plug (31) defective.	d. Replace.
2. Application time a. Clean Choke. exceeds 5 secs.	a. Choke (221) partially blocked/clogged.	a. Clean Chock.
	b. Valve (223) closing too soon.	b. Check the whole inshot Valve Assembly.
3. Leak at Release Choke (Q).	a. Defective surface condition of Valve (37).	a. Replace Valve.
4. Leak at (S) hole to atmosphere under reaction of brake cylinder pressure.	a. Diaphragm (27) of Main Valve incorrectly.	Relocate or replace.
	b. Defective „O" Ring (29)	b. Replace.
5. Leak at the Quick Service Chamber outlet (F).	a. Seal (58) of the Quick Service Outlet incorrectly assembled or defective	a. Relocate or replace.
6. Leak at the Cut-off Valve Cap (84).	a. Seal (83) improperly assembled or defective.	a. Relocate or replace.
7. Leak at the Inshot Valve Cap (87)	a. Diaphragm (77) of Inshot improperly assembled or defective.	a. Relocate or replace.
	b. „O" Ring (226) defective.	b. Replace

8.5.9 Brake Release Brake Pipe At 5 Bar

Operation Failure

Observations	*Causes of failure*	*Remedial Action*
1. Release time less than 15 secs.	a. Leak around Release Choke (55) and (231).	a. Open Exhaust Protector (92) remake the joint with sealing grease. Also open screw (53), remove Choke (231), apply grease on threads and retighten.

9.0 PARTS LIST

9.1 MAIN VALVE

Item	NO. FTIL Part NO.	Description	Qty/ASSY
1	501 1014 00	Body complete	1
3	501 3070 00	Diaphragm holder	1
4	501 7010 00BA	O Ring	1
5	501 7020 00BA	O Ring	1
6	501 7030 00	Diaphragm	1
7	501 8030 00	Spring	1
8	501 3080 00	Large Piston of lower diaphragm	1
9	501 7040 00A	O Ring	2
10	501 3090 00	Small Piston	1
22	501 3110 00	Diaphragm Follower	1
23	501 3120 00	Ring	1
24	501 7060 00A	Seal	2
27	501 7070 00	Diaphragm	1
28	501 3130 00	Diaphragm Clamp	1
29	501 7080 00A	O Ring	1
30	501 4041 00	Hollow Stem	1
31	501 4050 00	Plug	1
32	501 7090 00BA	O Ring	5
36	501 7110 00BA	O Ring	1
37	501 4060 00A	Valve Finished	1
38	501 8120 00	Cap	1
39	501 8130 00	Spring	1
61	920 0021 00	Hex. Screw	6
99	501 7330 00A	O Ring	1
--	011 3062 00	Choke	1

9.2 DOUBLE RELEASE VALVE

Item	NO. FTIL Part NO.	Description	Qty/ASSY
2	501 1131 00	Lower Cover Assy	1
11	501 8040 00	Valve Finished	1
12	501 8050 00	Spring	1
13	501 8060 00	Operating Lever	1
14	501 8070 00	Valve Operator	1
16	501 8080 00	Seat	1

Item	NO. FTIL Part NO.	Description	Qty/ASSY
18	501 8090 00	Valve Finished	1
19	501 8100 00	Spring	2
20	501 7050 00	Sealing Washer	2
21	501 8110 00	Cap	2
54	920 0151 00	Hex. Screw M6 x 30	2
54a	906 0110 00	Hex. Nut M6	2
56	501 4300 00	Choke	1
92	501 6040 00	Exhaust Protector	1
93	501 7200 00	Exhaust Ring Protector	1
233	5011 8300 00	Locking Rod	1
706	740 8118 00	Pulling Ring	1
707	501 8600 00	Threaded Cap	1

9.3 CUT-OFF VALVE

Item	NO. FTIL Part NO.	Description	Qty/ASSY
36	501 7110 00	„O‟ Ring	1
45	501 7120 00	„O‟ Ring	1
62	915 0020 00	Internal Circlip	1
63	501 4110 00	Spring Seat	1
64	501 8190 00	Spring	1
65	501 8200 00	Spring	1
66	501 4121 00	Solex Jet	1
67	501 8210 00	Spring	1
68	501 4130 00	Valve Finished	1
69	501 4140 00	Spring Seat	1
70	501 4150 00	Spring Seat	1
71	501 4160 00	Valve Finished	1
72	501 4170 00	Seat	1
73	501 8220 00	Spring	1
74	501 4180 00	Plug	1
75	501 4190 00	Valve Finished	1
76	191 2740 008	Guide	1
77	501 7160 00	Diaphragm	1
78	501 3270 00	Diaphragm Clamp	1
79	191 9530 008	Push Rod	1
80	501 7170 00	„O‟ Ring	1
81	501 7180 00	„O‟ Ring	1
82	501 1040 00	Diaphragm Clamping Screw Assembly	1

Item	NO. FTIL Part NO.	Description	Qty/ASSY
83	501 7190 00	Seal	1
85	501 8240 00	Spring	1
86	501 3170 00	Guide	1
84	501 3160 00	Cap	1

9.4 QUICK SERVICE VALVE

Item	NO. FTIL Part NO.	Description	Qty/ASSY
17	915 0010 00	Internal Circlip	1
32	501 7090 00	„O‘ Ring	1
40	501 1030 00	Cover Assembly	1
41	920 0010 00	Screw M10 x 35	4
52	909 0050 00	Washer	1
57	501 7140 00	Sealing Ring	1
58	501 7150 00	Seal	1
59	501 8180 00	Valve Finished	1
60	501 4100 00	Bush	1
201	915 0030 00	Internal Circlip	1
202	501 8310 00	Spring Seat	1
203	501 8320 00	Spring	1
204	501 4220 00	Valve Finished	1
205	501 7210 00	„O‘ Ring	1
206	501 1050 00	Seat Holder Assembly	1
207	501 8330 00	Spring Seat	1
208	501 7220 00	Seat	1
209	501 3200 00	Washer	1
210	501 7230 00	„O‘ Ring	1
211	501 7240 00	„O‘ Ring	1
212	501 3210 00	Seat Holder	1
213	501 7250 00	„O‘ Ring	1
214	501 7260 00	Diaphragm	1
215	501 3220 00	Piston	1
216	501 8270 00	Spring	1
217	501 4240 00	Nut	1

Item	NO. FTIL Part NO.	Description	Qty/ASSY
218	501 7270 00	Seat	2
219	501 4250 00	Guide Plunger	1
9	501 7040 00	„O‟ Ring	1

9.5 AUXILIARY RESERVOIR EQUALISING CHECK VALVE

Item	NO. FTIL Part NO.	Description	Qty/ASSY
42	501 8140 00	Check Valve Spring	1
43	501 4080 00	Check Valve Finished	1
44	501 8150 00	Cap	1
99	501 7330 00	„O‟ Ring	1

9.6 INSHOT VALVE WITH PRESSURE LIMITING FEATURE

Item	NO. FTIL Part NO.	Description	Qty/ASSY
77	501 7160 00	Diaphragm	1
81	501 7180 00	O Ring	1
223	501 4260 00	Valve Finished	1
224	501 3230 00	Plug	1
226	5017280 00	O Ring	1
228	501 6060 00	Diaphragm Clamp	1
701	501 8560 00	Cap	1
702	916 0060 00	External Circlip	1
703	501 8570 00	Spring Seat	1
704	501 8550 00	Stem Adjusting	1
705	501 8580 00	Spring Housing	1
708	501 3540 00	Clamping Flange	1
709	501 8370 00	Spring	1
710	501 3500 00	Cup	1
711	501 3460 00	Guide	1
712	501 8590 00	Spring	1

9.7 MISCELLANEOUS

Item	NO. FTIL Part NO.	Description	Qty/ASSY
33	501 6020 00	Filter	1
34	501 4309 00	Choke	1
35	501 7101 00	Joint	1
47	501 6030 00	Filter	1

3.5 STOP COCKS

3.5.1 General

The Stopcocks (**DH7 – TE...**) are manually operated units serving to charge, shut off and vent compressed air systems in rail vehicles. Being designed for flange – mounting they are suitable for attaching to manifold panels.
DH7 – TE... stopcocks are available in the versions named in Table1. They differ according to the type of actuator used.

Table 1 Types of stopcocks

Type	Part No.	With actuator
DH7 –TE	I 88738	Thumb screw
DH7 – TEP	I 89517	Thumb screw, with lead seal
DH7 – TES	I 88748	Cylinder lock

The stopcocks can be operated at working pressures of between 0 and 10 bar, and used as 2/2 – or 3/2 – way valves (see the diagrams in Table 2).

A stopcock consists of a basic valve and a mechanical actuator. The basic valve is integrated in a cube shaped body that can be fastened to a mating flange. The actuator attached to the basic body is designed either as a cylinder lock or as a thumb screw which may be secured by a lead seal.
The actual cutoff valve is operated by the actuator which is connected to a camshaft.

3.5.2 Operation

Turning the actuator (thumb screw or cylinder lock) by 90° rotates the camshaft (3) and moves the valve tappet (2) accordingly.

The valve tappet alternately opens and closes one of the two valve seats (V1, V2), setting up the corresponding paths from port A1 or A2 to port A3.

The port A2 at valve seat V1 is sealed off when the path from A1 to A3 is open. The port A1 at valve seat V2 is sealed off when the path from A2 to A3 is open.

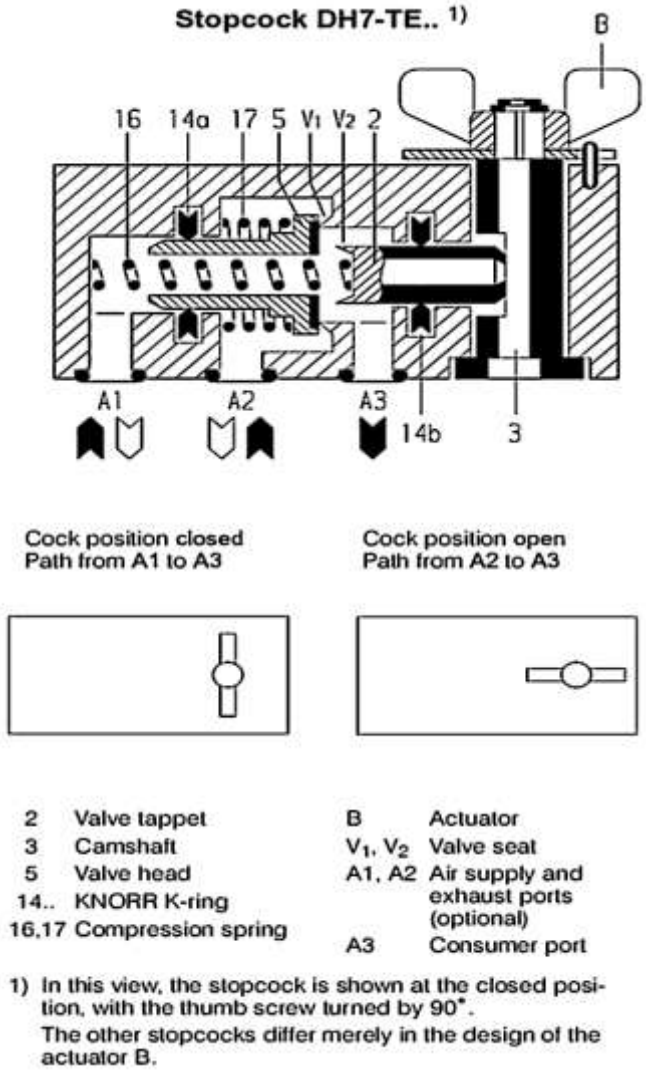
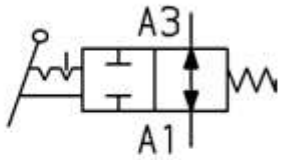
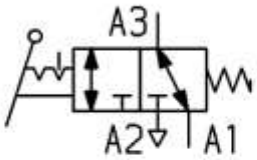
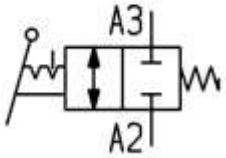
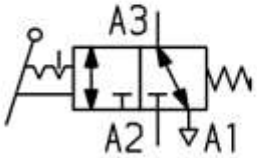


Figure: -3.6 Stop cocks

Table 2 Graphical symbols representing the stopcock

2/2-way valve	3/2-way valve
 A2 closed with a dummy plug C 12763/8	 C 12763/10
 A1 closed with a dummy plug C 12763/9	 C 12763/11

3.5.3 Installation

Being sealed by O – rings at its three ports, the stop-cock can be flanged directly to a manifold panel or attached to a pipe bracket in a pipeline system the stopcock is positioned exactly by two 4mm diameter dowel pin (32) which fit in the flange face of the body. The stopcock is held tight by two M6 machine screws.

3.5.4 Periodic Maintenance

The stopcock must be checked for good external condition and proper operation at regular intervals.

3.5.5 Troubleshooting (please refer to Fig.3.6)

Problem	Cause	Remedy
Air discharging constantly from exhaust port A1 or A2. Note: Provided the cock is working correctly, air may only be discharged briefly to vent pipe A3.	Valve seat V1 or V2 on valve tappet (2) and/or valve bushing (7) is dirty or damaged, or the rubber part of valve head (5) is defective.	Clean the valve seat. Replace any part found to be defective (2, 5 or 7).
	KNORR K–ring (14 a) defective	Replace the KNORR K-ring
	Compression spring (17) defective	Replace the compression spring.
Air discharging constantly from the body.	KNORR K–ring (14 b) defective	Replace the KNORR K-ring

3.5.6 Removal and Installation

Before detaching the stopcock, shut off the supply of compressed air and entirely vent the pipes connected to the unit.

Before attaching the stopcock, thoroughly clean the flange surface on the base plate or pipe bracket. Coat the three O- rings with a thin coat of universal grease and place them in their hollows at the connecting ports on the body.

Having attached the stopcocks, charge them to the maximum working pressure. Then test for leakage at the flange joint with the base plate or pipe bracket, with the actuator set alternately to both positions. Carry out the leakage test using a soap solution. All traces of soap must be removed immediately after the test.

3.6 CHECK VALVE

Check Valves RV 7-T and RV 19-T are designed for mounting on manifold panels. When the air delivery is interrupted, the Check Valves prevent air which has already been delivered from flowing back out of reservoirs and pipes. The Valve has a damped opening and closing action to prevent premature valve wear, vibrations and unpleasant noises caused by such vibrations. The damping action is provided by a cushion of air trapped in the guide (1) behind the stem of the valve (2).

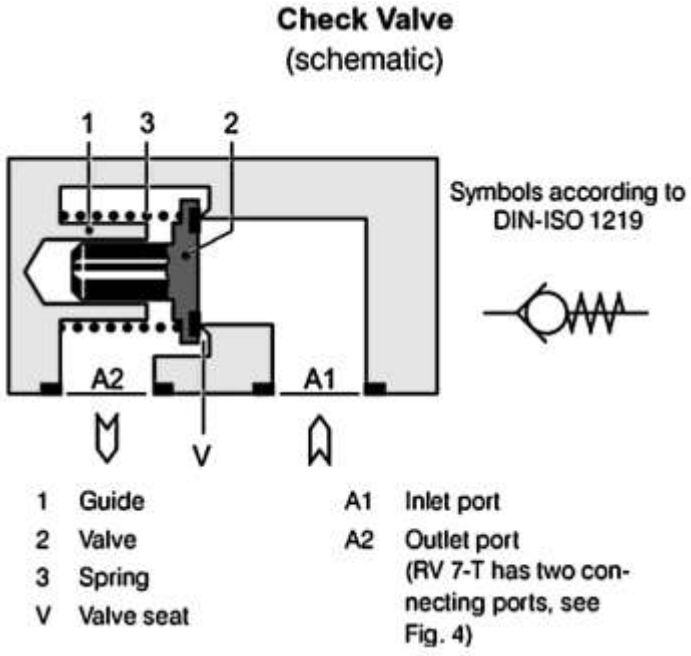


Figure: 3.7-Check Valve (Schematic)

3.6.1 Servicing

Check Valve must be checked for good external condition and proper functioning at regular intervals.

3.6.2 Trouble Shooting

Problem	Cause	Remedy
Air escaping back from A2 to A1 (Pressure drop at A2)	Valve seat V dirty or defective or rubber seal of valve (2) defective	Remove and disassemble check valve. Clean and/or recondition valve seat.
Air escaping at valve body	O-ring defective	Replace O-ring.

3.6.3 Removal and Installation

Prior to removing a check valve, fully exhaust the air pipes connected to it.

Prior to attaching a check valve, carefully clean flange mounting surface on the manifold panel and place O-rings in the body with a little grease.
Charge check valve after attaching. When the maximum working pressure is reached, test the flange joint between valve and manifold panel for leakage. Apply leakage testing agent; no air bubbles should from.

3.6.4 Overhaul

Disassembly

Standard tools are sufficient for disassembling the check valves. Do not remove dowel pins.

Cleaning

Clean all metal parts in a suitable cleaning bath at 70 to 80 degrees C and blow dry with compressed air. Clean valve (2 and 5) in lukewarm soapy water. Then rinse off immediately with clear water and dry with compressed air.

Inspection and Reconditioning

Visually inspect all cleaned parts carefully. If damages like cracks, deformations or heavy rusting are found, which do not allow the re-use of the part, replace as applicable.

For parts which require further inspection, table below identifies the necessary work together with an illustration of the part.

Table 1

Item	Designation	Remarks
1	Body (Fig.3.8)	Minor scratching in the valve seat can be corrected by polishing. Otherwise replace the valve, as necessary.
2 and 5	Valve	Inspect rubber seat for damage. If the rubber is indented or swollen in excess of 0.4 mm replace the valve.
4	Spring (on RV 19 –T)	The spring force must be at least 9.7 N at a clamped length of 18 mm.
7	Spring (on RV 7 –T)	The spring force must be at least 8.3 N at a clamped length of 8 mm.

IV Assembly

Prior to assembling check valves, apply a thin coat of universal grease to all O-rings and to guiding and sliding surfaces.

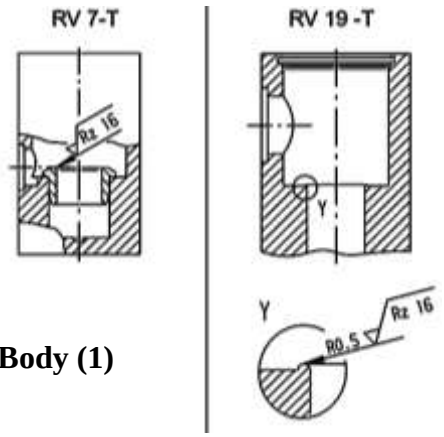


Figure: 3.8 –Body (1)

3.6.5 Testing

The following test brakes are needed for the test of check valve:

For RV 7-T: KNORR Part No. I 89616/39

For RV 19 –T : KNORR Part No. II 18137/06

Test Setup

Install check valve in a test setup according to Fig.3.9

- Close all cocks.
- Set pressure at pressure reducing valve to 10 bar (Pressure gauge M1)

Leakage Test

Open cock H1.

Pressure gauge M2 must read 9.8 bars at least. Test body for leakage, using a leakage testing agent No air should escape. The test may be performed with a soap solution. Soap residue must be removed immediately after the test.

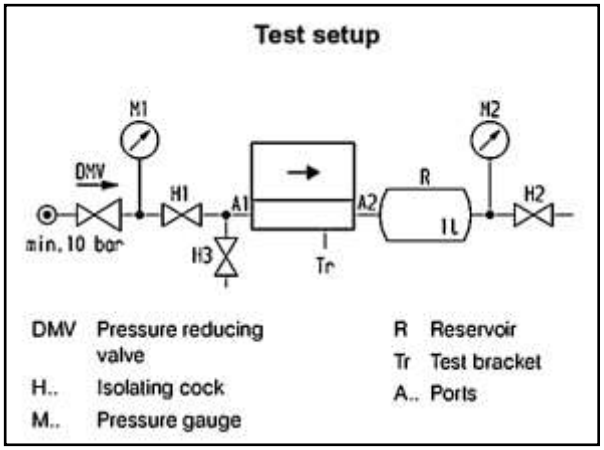


Figure: 3.9 –Test Setup

Function Test

Pressure gauge M2 still indicates the leakage test reading.

- Close cock H1
- Open cock H3

  The reading in pressure gauge M2 shall not fall.

  Apply leakage testing agent to cock H3.

  No air bubbles should from.
- Vent reservoir R through cock H2 until pressure gauge M2 reads 0.5 bar.

  Apply leakage testing agent to cock H3.

  No air bubbles should from.

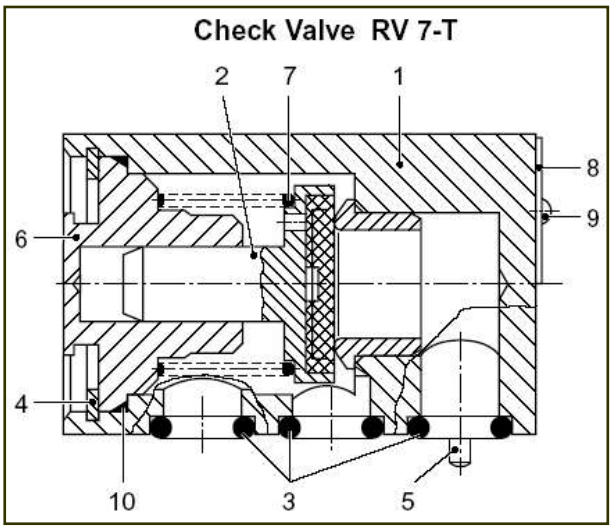


Figure: 3.10 – Check Valve RV 7 -T

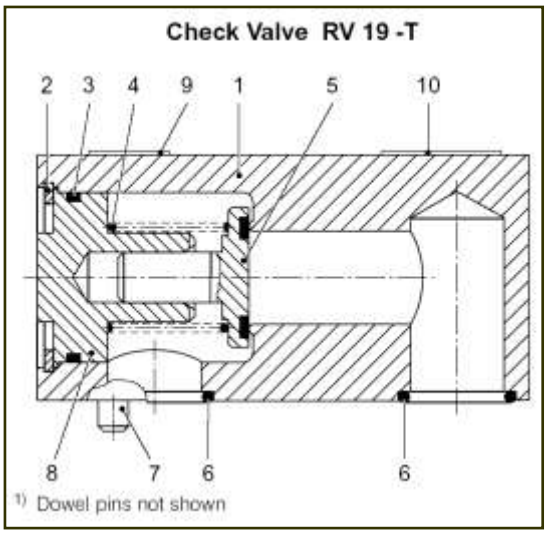


Figure: 3.11 – Check Valve RV 19-T

Termination of Test

- Close cock 1, open H2 and H3.
- Remove check valve from test setup.
- Affix a durable test mark to valves found good

3.7 PRESSURE TANK (AIR RESERVOIR)

The Air Brake System uses three reservoirs of capacities 125 litres, 75 litres and 6 litres. The locations where these are used are shown in schematic diagram of Air Brake system.

125 litre reservoirs is charged through feed pipe to the FP pressure. Air supply from 75 litre reservoir is used for Controlled Discharge Toilet system (CDTS).

Figure: 3.12 Air Reservoir

3.7.1 Servicing

Drain the condensate regularly from the air reservoirs through drain plug. Check for corrosion/damage or leakages at the weld seams.

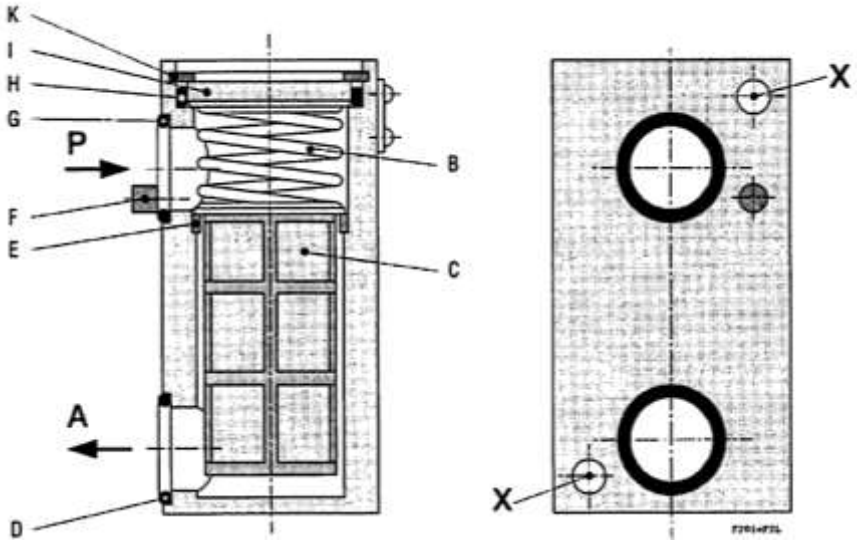
3.7.2 Hydraulic Testing

Air receivers should be hydraulically test at test pressure of 16 kg/cm^2 during shop schedules (POH).

3.8 FILTER FIL 100

3.8.1 Introduction

The filter FIL100 is a pneumatic filter. Figure shows the general structure of the filter and designates its main parts.
The function of the device consists of forcing the passing of air through a filter insert C. The pressure spring B fixes the filter insert in its correct position. The filter insert withholds particles larger than approx. 0.1 mm, protecting devices down-stream from contamination, malfunction and damage.



B	Pressure spring	H	O-ring: Housing
C	Filter insert	I	Cover
D	O-ring: Air outlet	K	Circlip
E	Back-up ring	P	Air inlet
F	Code pin	A	Air outlet
G	O-ring: Air inlet	X	Fixing bore

Fig.3.13 Test Fitting K1-E (Schematic)

3.8.2 Installation:

- Mount the device vertically, i.e. with the cover I on top.

3.8.3 Maintenance: Check the device at regular intervals.

You recognize a defective device on following symptoms.

- Dirt deposits in the lines and downstream devices: Filter defective
- Pressure drop: Filter dirty, partially clogged.

3.8.4 Technical Data

❖ Medium:	Air
❖ Maximum Pressure:	10 bar
❖ Orifice cross-section:	Approx. 280 mm2 (Φ19 mm)
❖ Filter Mesh:	0.1 mm
❖ Connecting diameter:	18 .. 19 mm

3.9 TEST FITTING (K1-E)

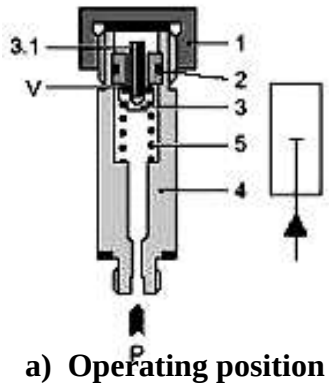
3.9.1 General

The test fitting K1-E is mounted on brake control units or installed in pipeline systems to test pressures in compressed air system. The test fitting consists of the body (4). The screw cap (1) and the spring –loaded valve head (3). The screw cap on the test port serves to keep out dirt. So it should be screwed back on again at the end of the test.

3.9.2 Operation

a) Operating position

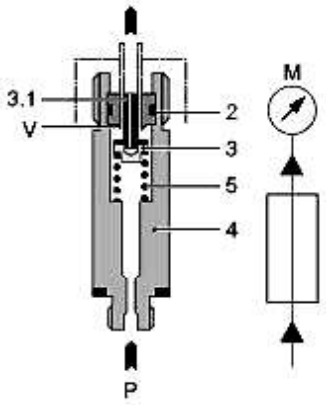
The test fitting‟s test port is sealed with screw cap (1). The valve head (3) is held at its top end position by the compression spring (5), and by the applied line pressure. The valve seat V is thus closed.



a) Operating position

b) Pressure measurement

The universal test connection (part no. 187308) is set as per Fig. 3.14 and connected to a pressure gauge required for the test. Having removed the screw cap (1). Screw the test connection onto the test fitting for the pressure measurement. The tappet (3.1) is forced downwards, allowing compressed air to flow from air supply port P through the open valve seat V to the test port. The applied pressure can thus be measured with a pressure gauge via the universal test connection.



b) Pressure measurement

1	Screw cap	M	Pressure tester
2	O-ring	V	Valve seat
3	Valve head	P	Air supply port
3.1	Tappet	4	Body
5	Compression spring		

3.9.3 Servicing

Test fitting must be checked for good external condition and proper functioning at regular intervals.

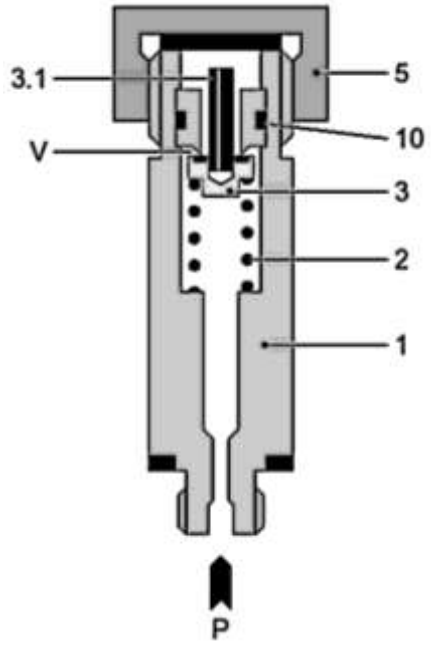


Fig. 3.15 Test fitting K1-E (Schematic)

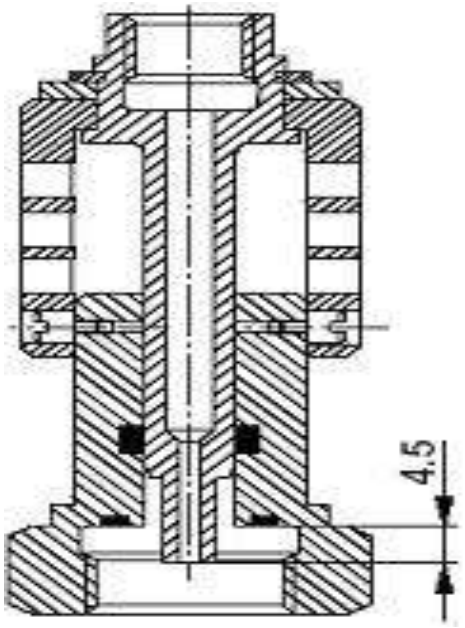


Fig. 3.14 Universal Test Connection

1. Body
2. Compression
3. Valve seat
3.1 Tappet
5. Screw cap
10. O-ring spring
V Valve seat
P Air input

3.9.4 Troubleshooting

Problem	Cause	Remedy
Air blowing off constantly when screw cap (5) is released.	Rubber seal of valve seat (3) defective.	Replace the Valve seat.
	Compression spring (2) defective	Replace the compression spring.
	O-ring (10) defective.	Replace the O-ring.

3.10 INDICATOR

The indicator (AZ-7) serves to indicate the braking condition of the compressed air brake on rail vehicles fitted with disc brakes. The display is realized by the signal color green or red showing up in the window of the unit.

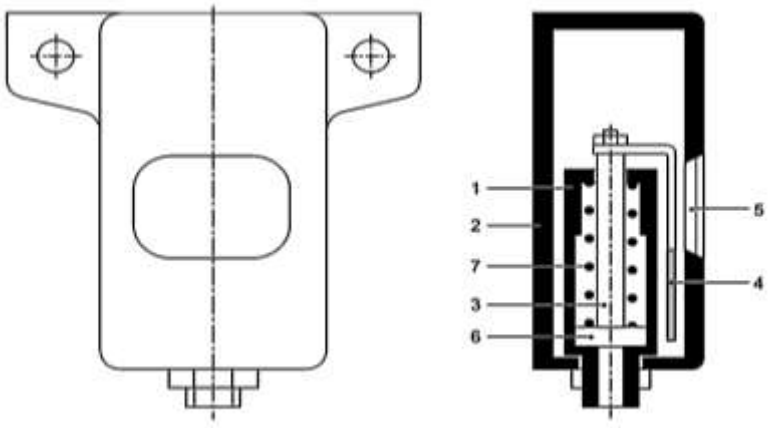
With a brake cylinder pipe pressure below 0.6 bar, the signal color is green – with a pressure above or equal to 0.6 bars, the signal color red with black dot appears in the window.

3.10.1 Operation

The indicator plate 4 fastened to the piston rod 3 is subdivided into two color fields (green red). Just one color field is visible at a time through the Plexiglas window 5 in the housing

With a pressure of less then 0.6 bar in cylinder 1, piston 6 is pushed into its lower end position by the force of spring. Window 5 only displays the green color field of indicator plate 4.

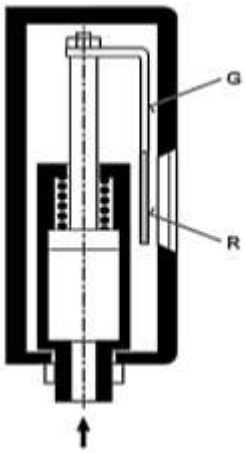
With a pressure above or equal to 0.6 bar in cylinder 1, piston rod 3 with indicator plate 4 is pushed to its upper stop. The red color field of indicator plate 4 becomes now visible through window 5



1. Cylinder
2. Housing
3. Piston Rod **INDICATOR**
4. Indicator Plate
5. Window
6. Piston
7. Compression Spring

G. Color field green

R. Color field red



3.10.2 Installation

With a view to the fact that the housing needs venting at the bottom side, the indicator must always be installed with the pipe union pointing downwards. It may be fastened by means of angular mounting plates to a vertical or horizontal surface.

Max. tightening torque for pipe fittings to be screwed in: 20Nm.

The Plexiglas window must not be varnished and be protected from blows and scratching. For cleaning, only use water and never aggressive cleaning agents

3.10.3 Commissioning

- Prior to installation and commissioning, the supply pipe must be thoroughly blown out.
- Having connected the pipe, check the connection fitting for pressure –tightness. Max. permissible pressure: 10 bar

3.10.4 Maintenance

Keep the window in cover clean, and check regularly whether the acrylic glass pane behind the cover is broken. If it is, water will penetrate the unit and cause damage.

Troubleshooting

Problem	Cause	Remedy
The sector does not change color correctly when pressure is applied	1. Knorr K_ring in piston is leaking 2. Piston is stiff as a result of corrosion caused by water penetrating the window	Overhaul the indicator, replace the KNORR K_ring. Overhaul the indicator
	3. The connected air supply line leaks	Tighten the pipe fittings
The colored sector does not return to its starting position when the pressure is vented	1. Compression spring is fractured 2. Piston is stiff as a result of corrosion caused by water penetrating the window	Replace compression spring Overhaul the indicator.

3.11 CUT OFF ANGLE COCK (SEE FIGURE)

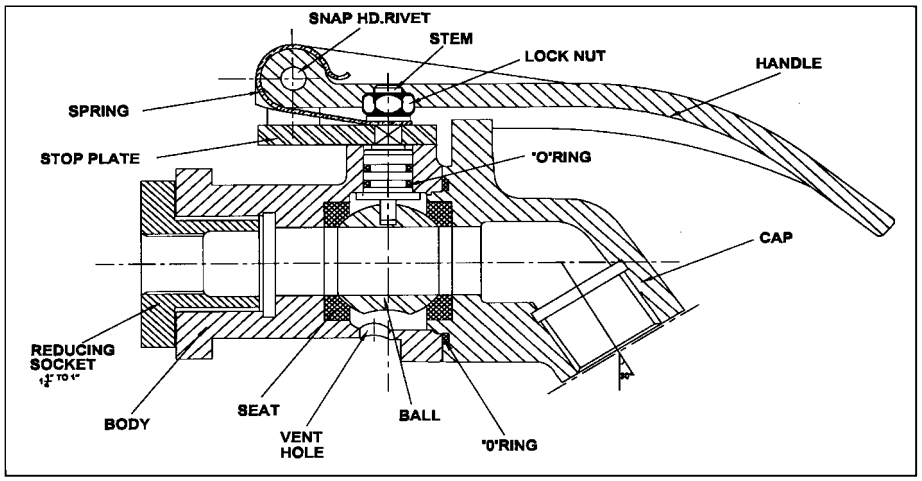


Figure 3.16 Cut Off Angle Cock

Cut off angle cocks are provided both on brake pipe & feed pipe on either end of each coach to facilitate coupling and uncoupling of air hoses. When the handle of the cut off angle cock is placed in closed position it cuts off the passage of compressed air, thereby facilitating coupling and uncoupling action.

The cut off angle cock consists of two parts viz. cap and body which are secured together by bolts. The cap and the body together hold firmly the steel ball inside it, which is seated on nitrile rubber seat. The ball has a special profile with the provision of a groove at the bottom portion for venting the air to the atmosphere.

On the top surface of the body a bore is provided for placing the stem, to which a self locking type handle is fixed. When the handle is placed parallel to the cut off angle cock the inlet port of the cut off angle cock body is connected to the outlet port, through the hole provided in steel ball. Thus air can easily pass through the cock. This position of the handle is known as open position. When the handle is placed perpendicular to the cock body the steel ball gets rotated and the spherical and groove portion of the ball presses

against the sealing ring at inlet and outlet port, there by closing the passage of inlet air and venting the outlet air through the vent hole. This position of the handle is known as closed position.
With the stem one leaf spring is provided which presses the operating handle downwards. By virtue of this, handle gets seated in deep grooves at ON / OFF position resulting in a mechanical lock.

Under normal working conditions, the handle of all cut off angle cocks of BP are kept open except the rear end angle cocks (BP). This facilitates in charging the complete air brake system with compressed air supplied by the compressor housed in the locomotive. Cut off angle cock fitted on the brake pipe is painted green.

3.11.1 Overhauling of Cut Off Angle Cock

The cut-off angle cock is to be completely dismantled and overhauled in every POH or when there is some specific trouble. During overhauling, it is dismantled for cleaning, replacement of parts and checking for effective functioning.

3.11.2 Tools & Equipment

The following tools and fixtures are required for overhauling

(a) Single end spanner.
A/F 17 for M10 nut pivot screw.
A/F 10 for M6 nut.
(b) Screw driver 12”/300 mm long.
(c) Vice.
(d) Light hammer.

3.11.3 Procedure

i) Dismantling

- Hold the cut – off angle cock in a vice.
- Unscrew the lock nut from the stem.
- Take out the handle assembly (The handle assembly need not be dismantled further unless it is necessary to change the plate spring i.e. if it is found, heavily rusted, pitting crack or the spring is permanent set).
- Unscrew the four hexagonal bolts and spring washers.
- Detach cap from the body.
- Remove „O“ ring and ball seat from the cap.
- Turn the stem in such a way that the ball can be pulled from the stem.
- Slightly hammer the stem at its top and take out the stem through the bore of the body.
- Remove the ball seat from the body.

ii) Cleaning of Parts

- Clean out side portion of the body and cap with wire brush.
- Direct a jet of air to remove the dust.
- Clean all metallic parts with kerosene oil and wipe dry.

iii) Replacement of Parts

- Replace all rubber parts.
- Replace spring-washer, nut & bolts in case they are excessively corroded or defective.
- Replace handle spring if it is found heavily rusted, is having pitting crack or is permanently set (Dismantle the handle assembly, and fit a new spring along with a snap head rivet).
- Replace stainless steel ball if found with scratch marks on the outer surface or dented.

iv) Assembly

- Insert the two „O" rings in their respective grooves on the stem.
- Keeping the threaded end of the stem first, insert the stem into the body through the bore of the body.
- Place one ball seat in its groove inside the body.
- Position the ball after correctly aligning its venting slot in the bore of the body.
- Place the second ball seat and „O" ring in their respective positions on the cap.
- Secure the body and cap by Hex. Hd. Bolt (M6) and spring washer (for M6).
- Place the handle assembly on the stem and secure it with Hex. Hd. Nut (M10).
- During assembly apply a light coat of shell MP2 or equivalent grease on the external surface of the threads and the ball.

3.12 BRAKE PIPE COUPLING (H-13/8 X R 1 ¼")

The brake pipe coupling serves to link together the parts of the continuous brake pipe on pneumatic brake systems on rail vehicles.

A Coupling head

K Mark of ownership

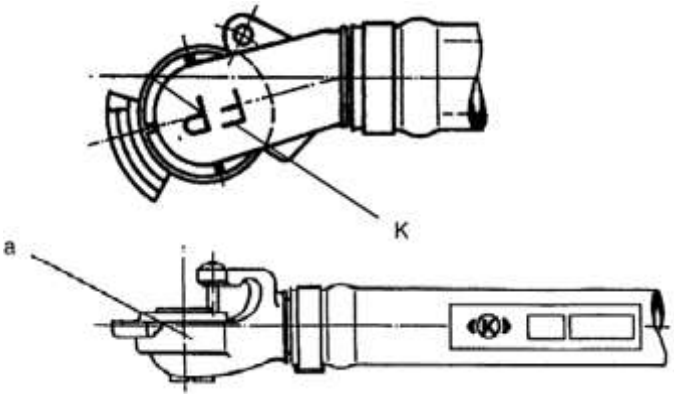


Figure: 3.17 Construction of the brake pipe coupling

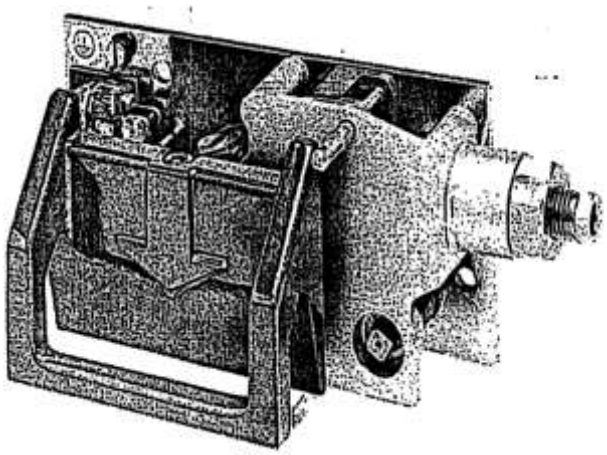
The brake pipe coupling links the continuous brake pipe between two cars or vehicles. The brake pipe must be cut off and vented on board the vehicle before the coupling heads can be taken apart.

3.12.1 Function test

Test the air pipe connections for leakage upon reaching the maximum acceptable working pressure. Apply a leakage testing agent. Air bubbling is unacceptable. The test may be performed with a shop solution. All traces of soap must remove immediately after the test.

NOTE: The hose clamps and sealing ring must be exchanged for new ones at every overhaul.

3.13 EMERGENCY BRAKE PULL-BOX



3.13.2 Introduction

The emergency brake pull-box (NPZ-1S) is used to control the train brakes. The code **S/2S** in the type designation indicates that the unit may have one or two switches.

3.13.2 Construction

Design Features

The emergency brake pull-box consists of housing and a handle. The housing contains a spring-loaded piston valve, as well as one/two electric switches. The unit contains a mechanism for resetting the handle.

Structural Features

Pulling the handle of the emergency brake pull box opens the built-in piston valve and vents the brake pipe connected to the brake system. This is the start of emergency braking. The position of the handle is ignaled to the train controller by one or two integrated switches. After the emergency brake pull-box has been operated, it can be restored to its home position with a carriage key (or reset lever).

3.13.3 Function Test

Admit air to the control air pipe. Test the pipe union for leakage when the maximum acceptable working pressure is reached. Carry out the leakage test by applying a soap solution. All traces of soap must be removed immediately after the test.
The emergency brake pull-box must be checked for good external condition and correct operation at regular intervals.

a. Procedure for Function Test

- Pull the handle (I). The control pressure (SD) is discharged through the valve opening (O) and brake application is started. The snap-action switch (q) is operated simultaneously by lever (g).
- The switch contact must be closed now.
- Turn the reset wheel (h) home clockwise with a square key. The handle (I) must be returned to its home position by this movement. The valve is closed.
- Emergency braking is overridden when the control pressure (SD) is applied again.
- The switch contact must be open now.

Seal the handle (I) with pin (h) once the function test has been completed successfully.

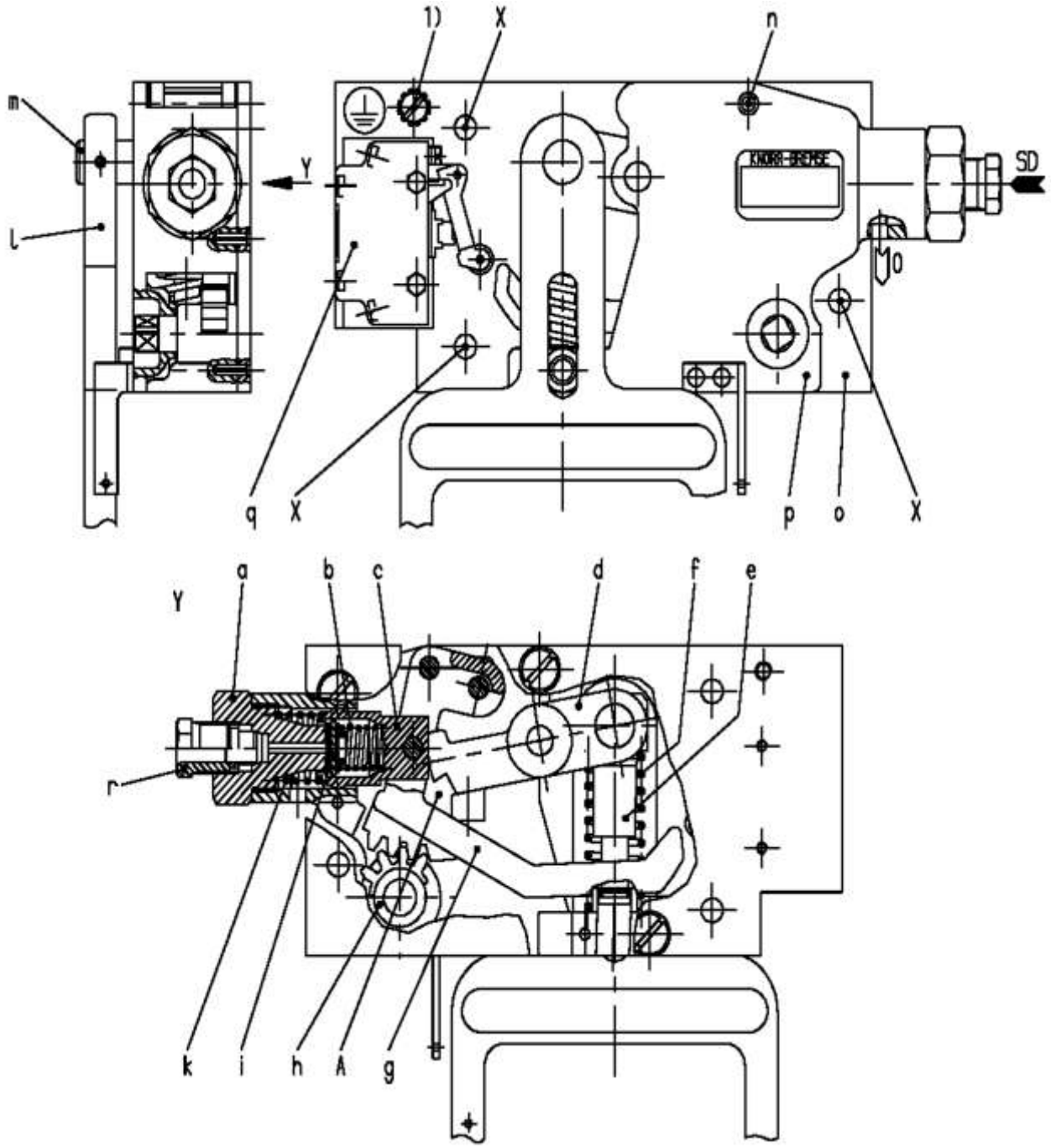


Figure: 3.18 Emergency Brake Pull-box

a Union screw b compression spring c Piston d Swivel latch
e Guide pin f Compression spring g Lever h Reset wheel
I Valve head k Compression spring l Handle m Tie bolt
n pin o Base plate p Housing q Snap action switch
r Cap screw A Swivel latch notch O Valve opening SD Control pressure
X Holes for fastening screws 1) Grounding screw

3.13.4 Operation and Handling

The emergency brake pull-box is designed for operation by passengers in an emergency and requires no kind of intervention by the driver.

3.13.5 Periodic Maintenance

Maintenance is carried out in situ and consists in checking the unit for leakage and correct operation. The emergency brake pull-box will have to be overhauled if it is found to leak or malfunction.

3.13.6 Trouble shooting

Problem	Cause	Remedy
Unit not shutting electrically when the handle is operated or the reset wheel (h) is turned	- No power supply to snap-action switch (q) - Loose power cable to snap action switch (q) - Snap –action switch (q) defective - Reset wheel (h) jammed	- Restore the power supply - Clamp the power cable correctly in place. - Exchange the snap-action switch - Make the reset wheel move again. Exchange if necessary.

3.13.7 Specifications

Max. acceptable working pressure	10 bar
Max. voltage across the switch	110 VDC

3.13.8 Overhaul Instructions

Please refer to OEM"s instructions for overhauling and spare parts list.

3.14 EMERGENCY BRAKE VALVE

The Emergency brake pull box and Emergency brake valve communicate with one another through a control line. The emergency brake valve is connected to the brake pipe.

3.14.1 Construction (please refer to Fig.)

The emergency brake valve consists of a body (1) having a brake pipe port L, a control port St, a control chamber K and an exhaust port O. A piston on the piston rod (2) separates the control port from the control chamber and controls a valve seat V in the L chamber. As long as the valve is in its inactive state, the valve seat V is kept closed by the force of the compression spring (3).

3.14.2 Design Features

The series NB12.. emergency brake valves have a second compression spring (3) which the series NB11.. valves do not have. The elevated force of these springs causes the valve seat V to close earlier, and prevents the brake pipe L from venting entirely.

The series NB12.. emergency brake valves restrict the residual pressure in the brake pipe L to about 2 bars. As a result, the time needed to fill the brake pipe can be shortened substantially.

3.13.3 Operation

a. Filling the Emergency Brake Valve

The emergency brake valve is charged with pressure when the brake pipe L is filled. The control port St receives the same pressure through the ports a and b. The air flows into the control chamber K through the port d and past the grooved K-ring (8). The control chamber K and the control line St are at the same pressure level as the L chamber. The emergency brake valve is ready for operation.

b. Emergency Braking

The pressure in the control line is lowered abruptly when a passenger pulls one of the emergency brake handles that is connected to the control port St. The pressure difference produced in this way between the control chamber and the control port chamber pushes the piston of piston rod (2) upwards, opening the valve seat V. The L pressure is discharged very quickly through the large bore of the exhaust port O, initiating an emergency brake application.

c. Venting the Control Chamber

The control chamber K is vented slowly past the grooved K-ring (4) and through the bore c. When the emergency application is completed, the valve seat V is closed again by the pressure of the spring (3).

d. Charging the Control Chamber

To find out which emergency brake handle has been pulled, the driver can charge the emergency brake valve pulse wise with pressure from the driver‟s brake valve. Air is admitted to the control chamber K through the port d and past the grooved K-ring (8), which acts as a check valve in this case. Since the air delivery fluctuates, a pressure difference forms again between the control chamber K and control port St, opening the valve seat V. The noise of the air discharged in this way shows which emergency brake valve has been operated.
The brake pipe L can be refilled after the emergency brake pull-box has been closed.

3.14.4 Installation

The emergency brake valves must be installed upright, i.e. the exhaust port O must point downwards.

3.14.5 Maintenance

The emergency brake valves must be checked for good external condition and proper operation at regular intervals.

Schematic of emergency brake valves NB11..and NB12…

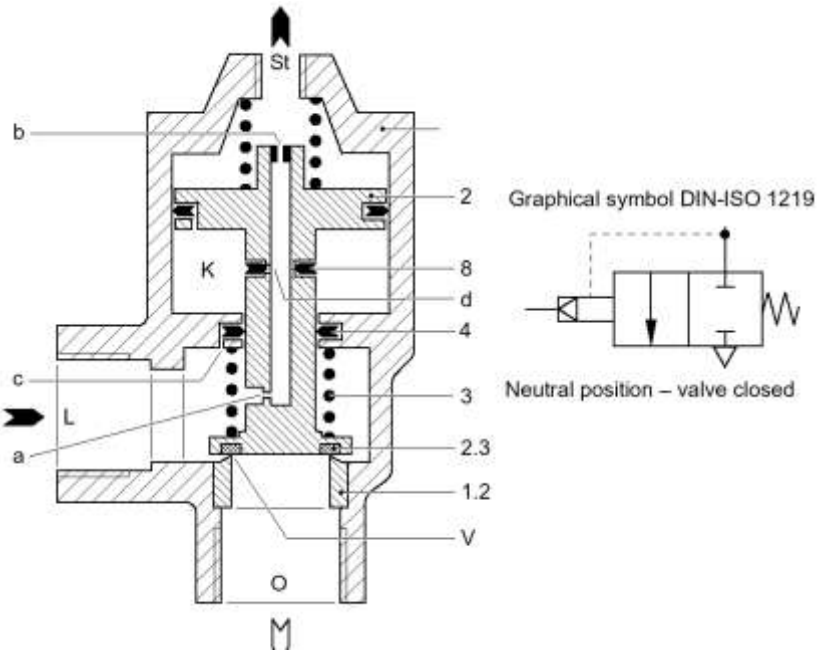


Figure: 3.19

1	Body	1.2	Valve bushing	2.3	Valve sealing ring
3	Compression spring	2	Piston rod	4	KNORR K ring
8	KNORR K ring	a,b,c,d	Control ports	L	Brake pipe
O	Exhaust	St	Control line	K	Control chamber
V	valve seat				

a. Troubleshooting, Table 1

Problem	Cause	Remedy
Air discharging constantly at exhaust O. Note: As long as the emergency brake valve is functioning correctly, the air must be discharged abruptly when the emergency brake handle is pulled.	Valve seat V dirty or damaged, or valve sealing ring (2.3) defective on piston rod (2)	Clean the valve seat and/or recondition the sealing surface of valve sealing ring (2.3) and the valve seat of valve bushing (1.2) –see Table 2, Items 1 and 2.
	Piston rod (2) sticking	Overhaul the valve
	Compression spring (3) defective	Replace the spring
The brake pipe L is not vented when the emergency brake handle is pulled.	Piston rod (2) sticking	Overhaul the valve
	The bores in piston rod (2) and/or threaded choke (2.2) are clogged	Dismantle and clean the valve

b. Removal and Installation

Before detaching the emergency brake valve, entirely vent the pipes L and St. Having attached the emergency brake valve, charge it to the maximum working pressure and then test the pipe fittings for leakage. Apply a leakage testing agent; no air bubbles should form. The test may be performed with a soap solution. All traces of soap must be removed immediately after the test.

c. Overhaul

Please refer to OEM‟s Instruction for overhauling and testing of Emergency Brake Valve.

3.15 BOGIE BRAKE EQUIPMENT

The Bogie Brake equipment consists of:

- Brake Caliper Units
- Brake Cylinder (with/without a parking brake)
- Brake Discs
- Brake Shoes (with snap lock gate)

Each axle is equipped with two brake discs. The brake energy is dissipated only at the brake discs, so the wheel set is only stressed by the weight of the coach. The advantage of this arrangement is that the superposition of the thermal stresses and mechanical stresses is avoided.

The braking force is generated for each disc by a brake caliper unit, which consists of a brake cylinder and the brake caliper, amplifying braking cylinder force depending on the lever ratio.

3.15.1 Brake Cylinders

U-series brake cylinders with automatic slack adjustment are used to operate the friction brakes in rail vehicles. these brake cylinders are essentially distinguished by their integral, force controlled slack adjustment mechanism which is designed as a single acting clearance adjuster. The working of this mechanism is not influenced in any way by the elastic brake rigging deflection, which varies according to the brake force. In the course of braking, the slack adjuster quickly and automatically corrects the increasing brake pad or brake block clearance due to wear.

Periodic Maintenance of Brake Cylinder

The Brake Cylinder bellows must be inspected externally for damage at regular intervals during operation so as to avoid soiling and associated working trouble in the slack adjuster mechanism. It is also necessary to check the vent plug and bellows relief valve for obstructions at regular intervals.

Overhaul

Please refer to OEM's manual for overhaul instructions & troubleshooting.

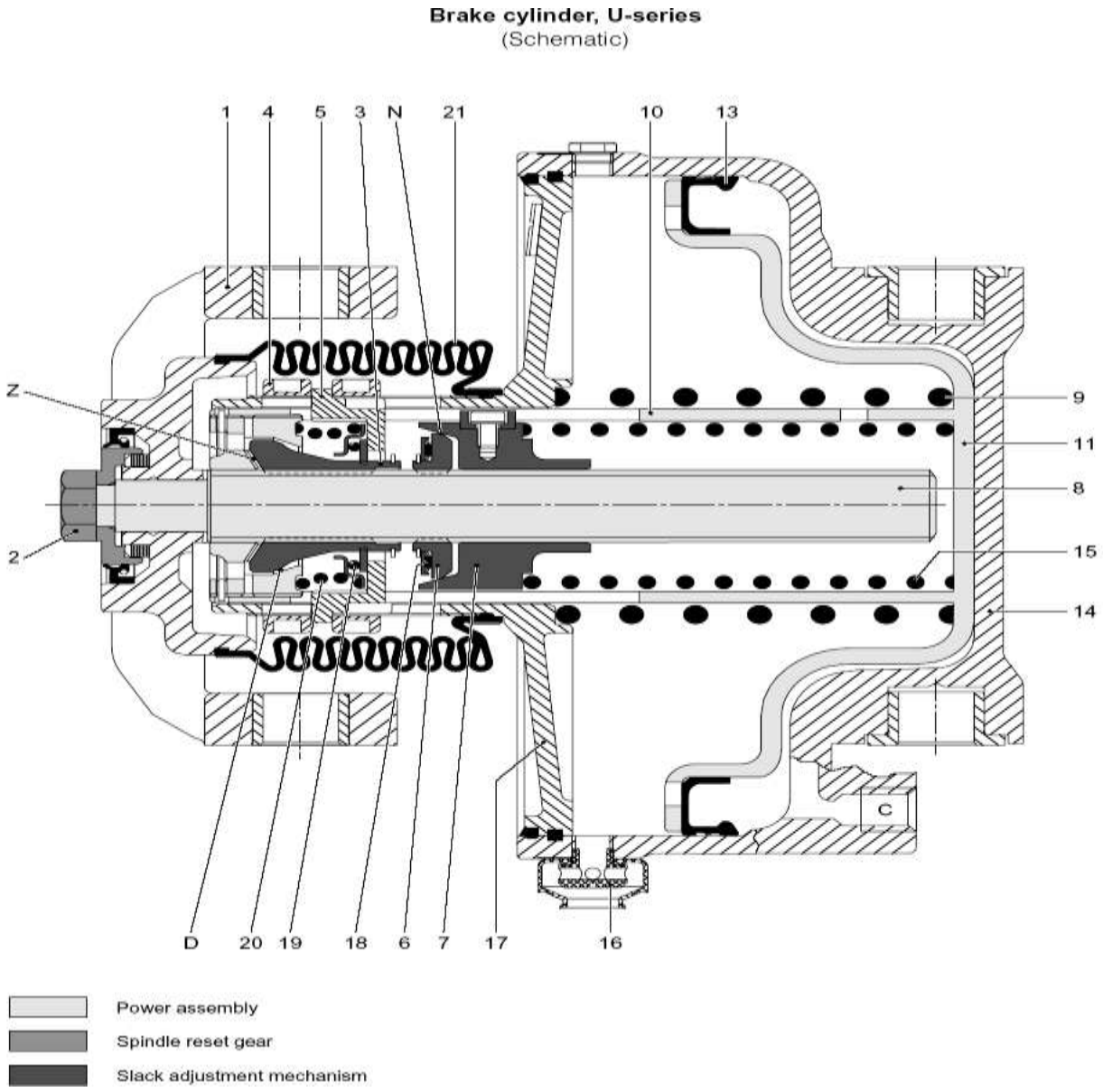


Figure: 3.20 Brake Cylinder U-Series (Schematic Diagram)

1 Yoke	8. Spindle	16 Breather plug	C Air supply port
2 Clamping nut	9 Compression spring	17 Cover	D Cone coupling
3 Thrust nut	10 Piston tube	18 Needle bearing	N Cone Coupling
4 Positioning ring	11 Piston	19 Ball bearing	Z Geared Coupling
5 Adjusting ring	13 Packing	20 Compression spring	
6 Nut	14 Cylinder	21 Bellows	
7 Coupling sleeve		15 Compression spring	

3.15.2 Brake Caliper Units

The brake caliper units are ready–to-use combinations of a brake caliper and brake–cylinder, providing automatic slack adjustment for wear (abrasion) on brake pads and brake discs. Consequently, the clearance required between the disc and pads for smooth running remains practically constant while the brakes are released.

Brake Caliper units consist essentially of the brake cylinder, the brake caliper, and the brake shoes with snap lock gates. The brake caliper units are held in the vehicle bogies by a three – point-mounting arrangement.

Working principle

Applying the service brake charges the brake cylinder and presses the brake pads against the brake disc. Brake force is built up when the pads are applied. Venting the brake cylinder releases the service brake. The return spring in the brake cylinder moves the caliper levers to the release position.

The handbrake lever is moved mechanically by the Bowden control cable when the parking brake is operated. The piston is pushed forward, and the brake pads are applied to the disc. When the parking brake is released, the caliper levers are drawn to the release position by the return spring in the brake cylinder.

Removal

- Released the compressed air piping from port C.
- Remove hangers and the bolted part of fixed mounting from the bogie.
- Take the brake caliper unit out of the bogie.

If only the brake cylinder is to be removed and the brake caliper is to be left in the bogie, un-screw the pivot screws and take brake cylinder out of brake caliper.

Maintenance

The brake caliper pin joints are greased sufficiently before leaving the workshop.

Use Kluber Staburags NBU 30 PTM grease for subsequent lubrication.

The hole in the exhaust plug (E) must be checked for obstructions with a rod – like tool. This check must be made at regular intervals.

Replacing the Brake Pads

The brake pad must be replaced before they are worn below their specified minimum thickness. Turn the reset nut R to the maximum possible caliper opening before replacing the brake pads. Always remember to release the brakes before attempting to open the gates locking the brake pad holders.

Having replaced the brake pads, apply and release the brakes several times, and then check the brake shoe clearance. (See function test)

Installation

Before installing the brake caliper units, set the caliper to its maximum possible opening with the reset nut R. Install the brake caliper units without brake pads. Only insert and lock the brake pads in the pad holders after installing the brake caliper units.

Prior to installation, measure the bearing bushings that hold the pins in the bogie. The maximum amount of wear allowed between the pins and bushings is 1mm. (0.5 mm each).

Insert and lock the brake pads in the pad holders after completing installation.

Repair and Overhaul

Please refer to OEM's manual for details.

Testing

The brake caliper units must be tested for correct operation after have been installed in the vehicle.

Function Test

A function test must be carried out after brake caliper units have been installed or worn brake pads replaced. Admit maximum working pressure to the brake cylinder. Test the screw fitting at air supply port C for leakage. No air is allowed to escape. Test the brake while the vehicle is stationary. Repeatedly apply and release the service brake or service/parking brakes (whichever is applicable). Test the service and parking brakes separately in succession. Check the brake shoes clearance S as follows after completing the function test.

WARNING: - lock the service and parking brakes at their release position in the driver's cabin.

- Apply one shoe of the brake caliper units to the brake disc and measure the distance of the other shoes from the disc. The reading must match the brake shoes clearance S specified for the vehicle. A clearance of S/2 must be left at each shoe when the brake caliper unit is hanging clear.

- If the brake clearance is too small, refer to Troubleshooting"

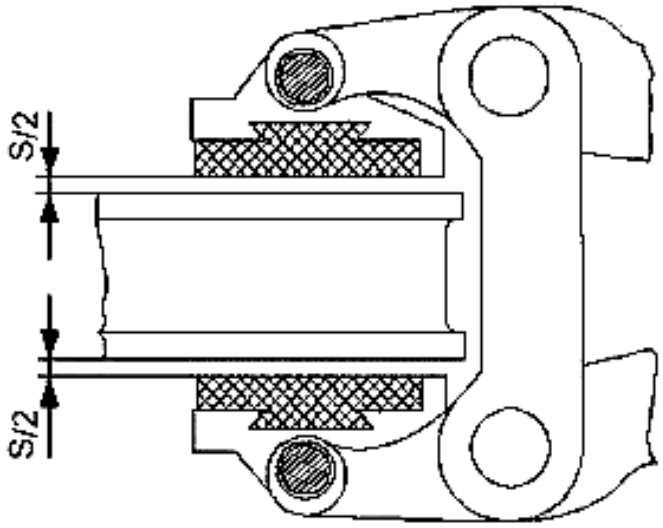
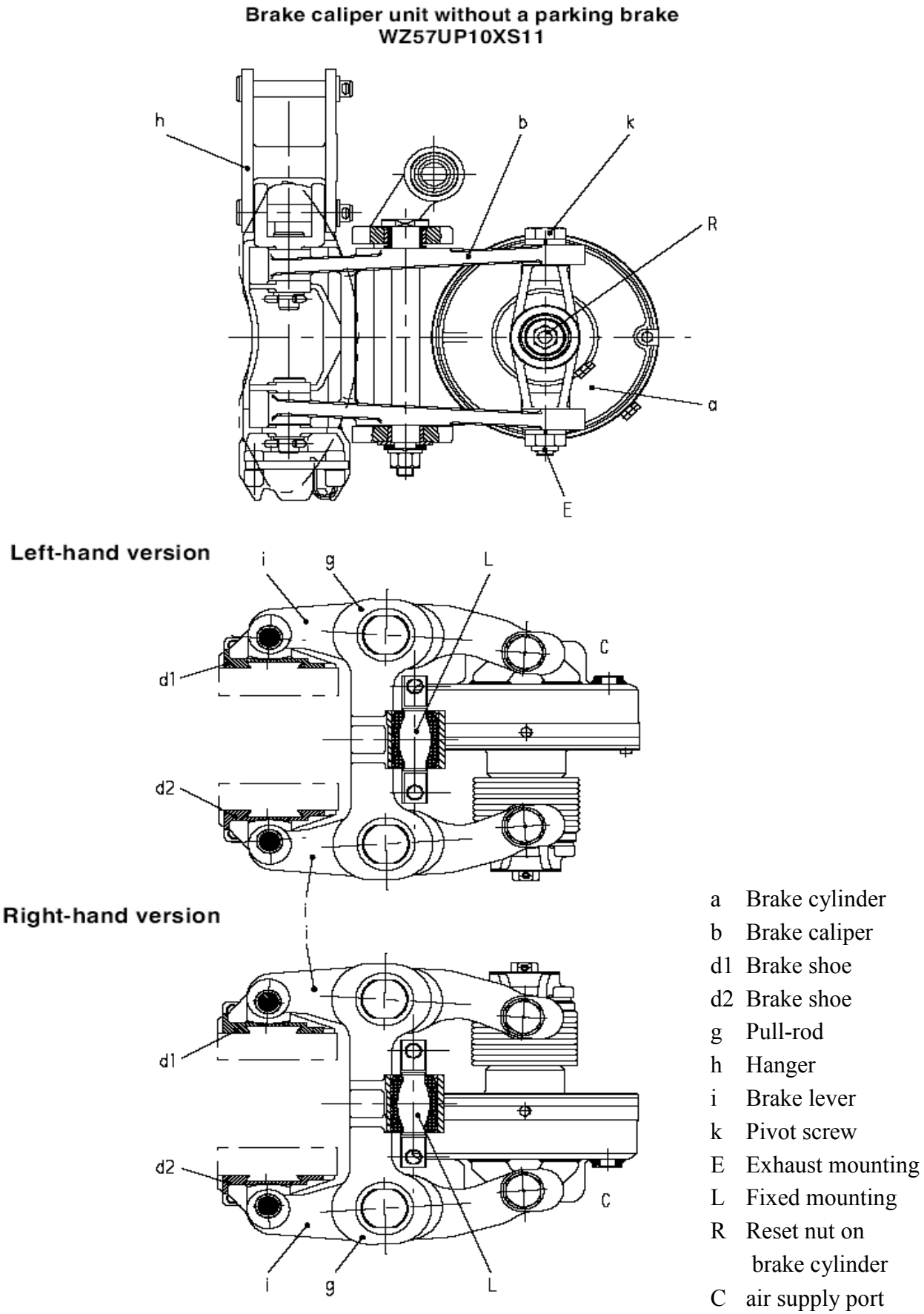
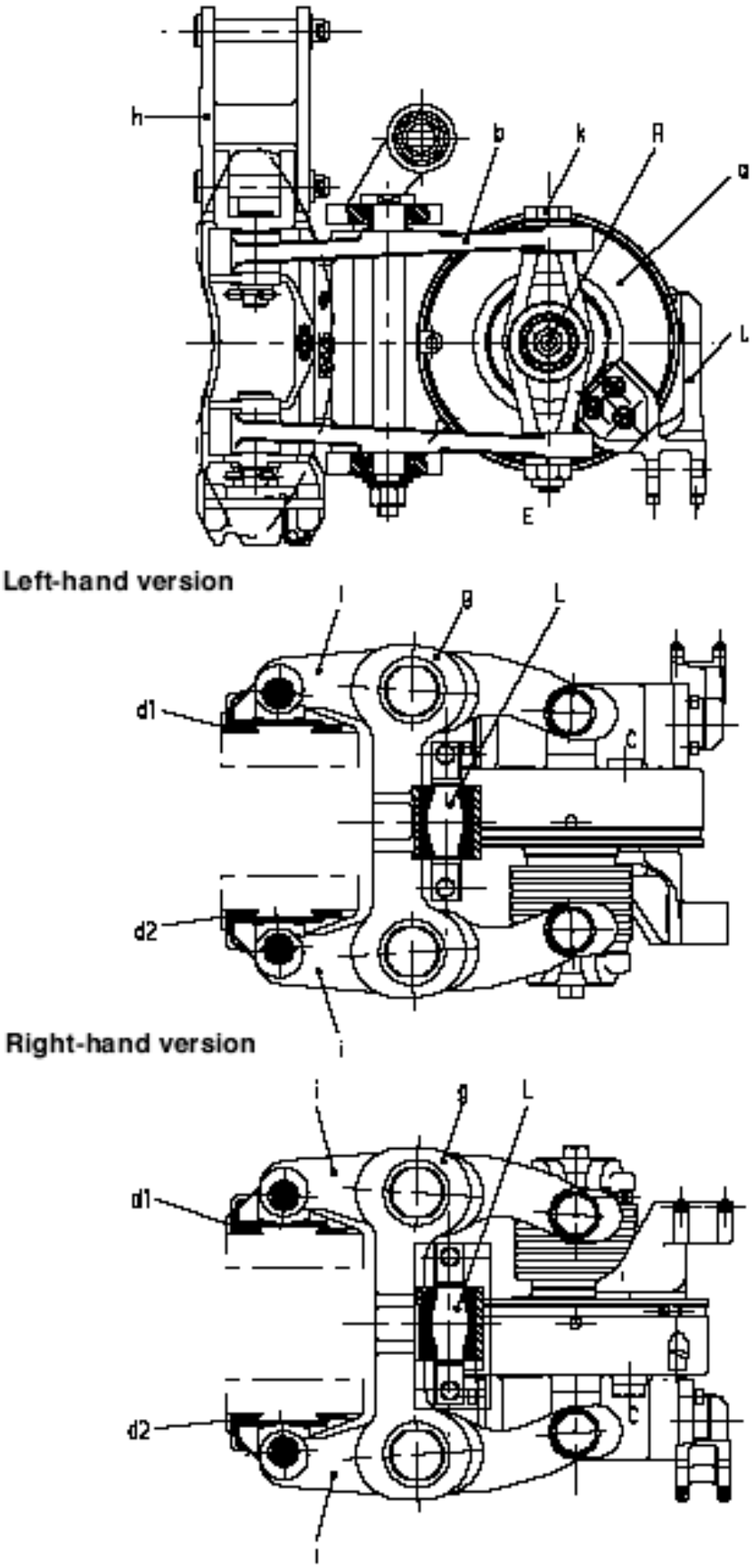


Figure: 3.21 Brake Shoe Clearance S



a Brake cylinder
b Brake caliper
d1 Brake shoe
d2 Brake shoe
g Pull-rod
h Hanger
i Brake lever
k Pivot screw
E Exhaust mounting
L Fixed mounting
R Reset nut on brake cylinder
C air supply port

Figure: 3.22 Brake Caliper unit without a parking brake



a Brake cylinder
b Brake caliper
d1 Brake shoe
d2 Brake shoe
g Pull-rod
h Hanger
i Brake lever
k Pivot screw
l Bowden control cable
m Handbrake lever
E Exhaust mounting
L Fixed mounting
R Reset nut on brake cylinder
C air supply port for service brake cylinder

Figure: 3.23 Brake Caliper unit with a parking brake

Troubleshooting

Problem	Cause	Remedy
Incorrect brake shoe clearance after repeated braking.	Brake cylinder application stroke is out of specification and is not returning the requisite caliper transmission	Correct the application stroke as directed by the overhaul instructions for the brake cylinder.
Brake shoe clearance too small or entirely absent after new brake pads have been fitted.	Adjusting spindle of brake cylinder is not entirely reset	Screw the adjusting spindle of brake cylinder back home with the reset nut.

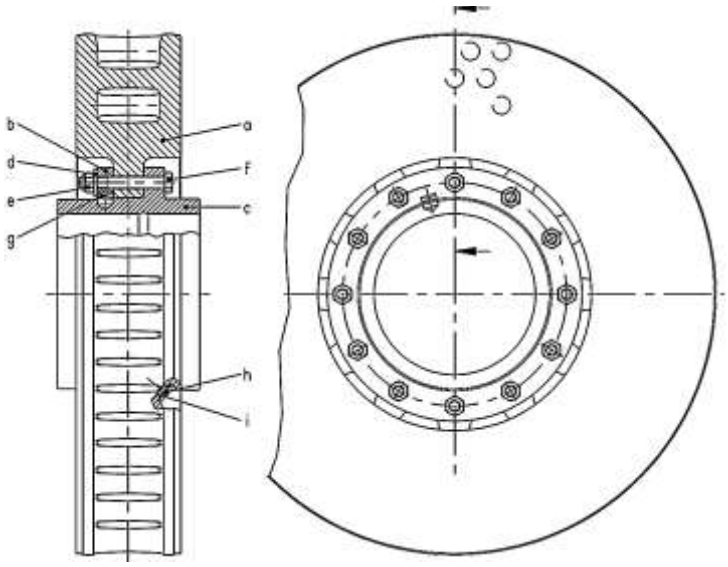
3.15.3 Axle Mounted Brake Disc

Introduction

The axle –mounted brake disc consists of a gray cast iron friction ring and a cast steel hub, connected by means of radically arranged elastic resilient sleeves which are secured in the hub by means of hexagon screws. The friction ring is manufactured as a solid component or in a split version. In the latter case, the two halves are held together by two tight –fit screws.

The axle- mounted brake discs are ring-shaped castings with crosswise cooling ribs. The brake discs have a groove around their circumference to show when they reach their condemning limit and have to be replaced

Axle- mounted brake disc



a. Friction ring
b. Clamping ring
c. Hub
d. Spring washer
e. Hexagon nut
f. Hex-head bolt
g. Anti-twist stud
h. Screw plug
i. Sealing ring

Structural Features

The axle-mounted brake disc consists of the friction ring (a) with integral cooling ribs and the hub (c). The crosswise cooling ribs carry off the heat and serve simultaneously to maintain a thermal balance within the friction rings.

Maintenance

The maintenance of the disc brake is in most cases restricted to the exchange of worn brake pads as the remaining thickness is down to 5 mm. If the friction ring shows any scores, excessive grooving etc. the necessary machining to be carried out when the wheel-set is being reconditioned. If as a result of an unusually heavy stress, the friction ring is worn before the wheel set, and the wear limit of 5 to 7 mm marked by a groove is reached, it is recommended that a split ring be used for replacement.

- The axle- mounted brake-disc must be checked for wear at regular intervals. Worn or defective brake discs must be replaced.
- The fastening screws must be examined for a tight fit.
- Loose friction rings signify loss of bolt tensioning force. The cause must be traced and corrected.
- Nuts must be tightened to the torques specified in the applicable installation drawing.
- The cooling ribs must be inspected for dirt deposits, and blown out with compressed air if necessary.

Type designation

W 640 B 110 P G U P

W	-	Axle- mounted brake disc
640	-	Dia of friction ring.
B	-	Ventilated.
110	-	Width of Friction ring
P	–	Flange seat
G	-	Gray cast Iron
U	-	Unsplit
P	-	Pneumatic

Note: It is advisable that the two Disc Brakes on the same axle should be of the same mark.

Overhauling

Please refer to OEM‟s instructions for overhauling, installation, removal and spare parts list.

3.15.4 Brake Shoe with Snap Lock Gate

The brake shoe with snap lock gate is provided with a brake pad holder carrying replaceable pads. The brake shoe consists of the brake pad holder, the vertical pins and the brake pad. The brake pad holder is provided with a dovetail guide into which the pad is slipped. The pad is held in place by a captive gate, which is pivoted at the pad holder. To lock the gate, a locking spring of spring steel has been provided which is pre-tensioned such that in one position it secures the gate in the pad holder and in the other (released) position it holds the gate open. For each brake disc a right and a left hand brake shoe are required.

Brake Lining Change

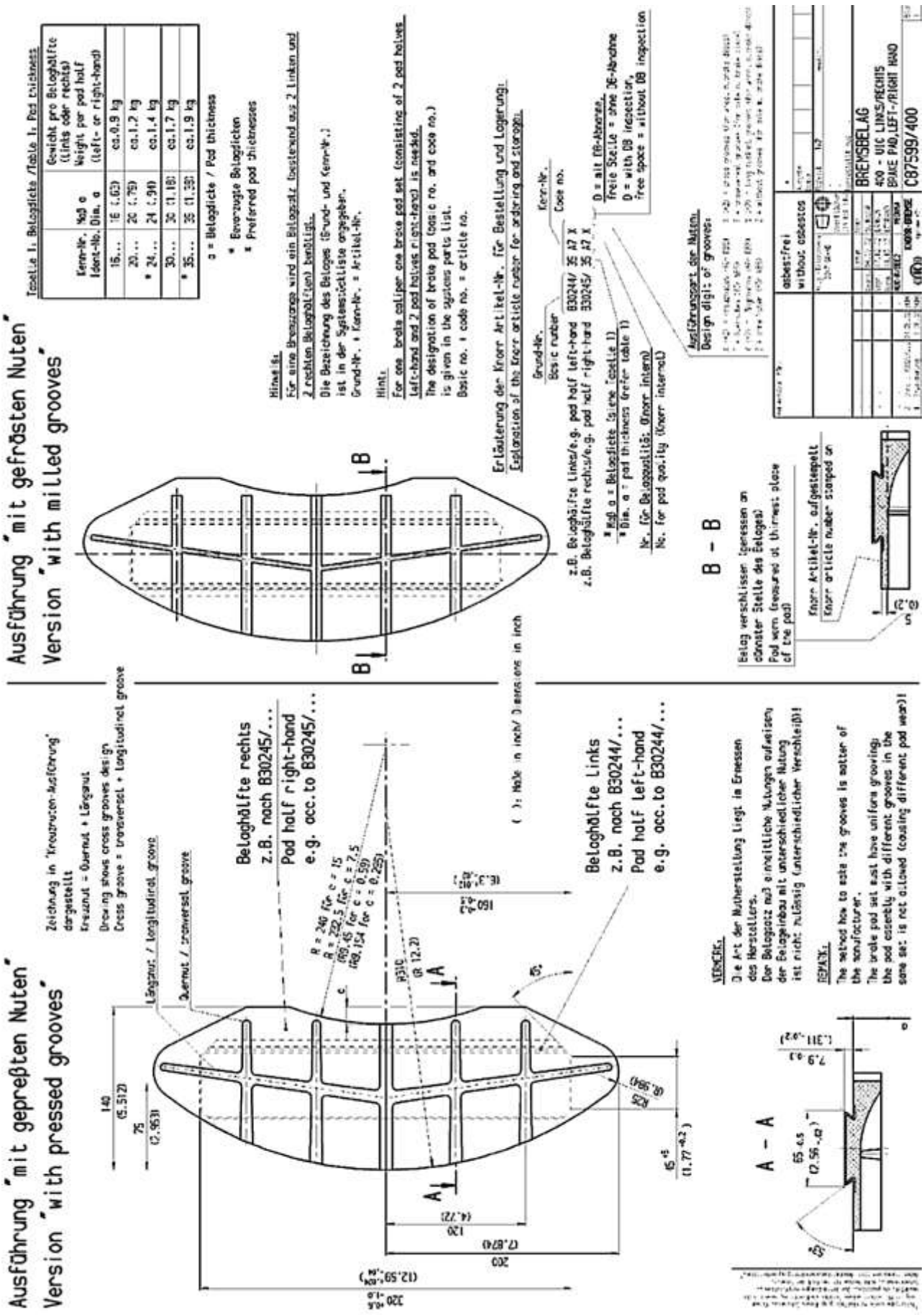
Worn brake linings must be replaced at a residual thickness of 5 mm at the latest. (at no point the residual pad thickness must fall below 7 mm)

Inspection of Pins and Bushings

Permissible wear between pins and bushings is 1 mm for any bearing point. When the permissible limit values are exceeded, the bushings and pins must be replaced.

Wear – Induced Replacement of Locking Spring and Locking Gate

In the closed condition, the locking gate must be tightly pre tensioned by the locking spring. Other wise the locking spring must be replaced. When replacing the locking spring or the locking gate always remove the resilient pin.


Ausführung "mit gefrästen Nuten"
Version "with milled grooves"
Ausführung "mit gepreßten Nuten"
Version "with pressed grooves"
Belaghälfte rechts
z.B. nach B30245/...
Pod half right-hand
e.g. acc.to B30245/...
Belaghälfte Links
z.B. nach B30244/...
Pod half left-hand
e.g. acc.to B30244/...
B - B
A - A
Hinweis:
Die Art der Nutherstellung liegt im Ermessen des Herstellers.
Der Belagsatz muß unterschiedliche Nutungen aufweisen, der Belageinbau mit unterschiedlicher Nutung ist nicht zulässig (unterschiedlicher Verschleiß)!
REMARK:
The method how to make the grooves is matter of the manufacturer.
The brake pod set must have uniform grooving; the pod cassetely with different grooves in the same set is not allowed (causing different pod wear)!
BREMSBELAG
400 - UIC LINKS/RECHTS
BRAKE PAD,LEFT-/RIGHT HAND
C87599/400

3.15.5 Wheel Slide Control Systems

3.15.5.1 Wheel Slide Control Systems (KNORR BREMSE, Series MGS2)

Introduction

The MGS2 system is a "microprocessor-based wheel slide control system. The control units are based on ESRA. i.e. Electronic System for Railway Applications.
The major parts of the system are: speed sensor, control unit, and anti skid valve.

Salient Features of MGS2 Series

The control logic of MGS2 system

- ❖ Reliably prevents the wheelsets from locking in all kinds of weather, even in the face of extremely low adhesion due to wet leaves on the rails.
- ❖ Regulates the brake force at low adhesion values, greatly improving the mean coefficient of adhesion and minimizing the stopping distance.
- ❖ Consumes little compressed air, even when braking is prolonged and adhesion is low and avoids depleting the brake system.

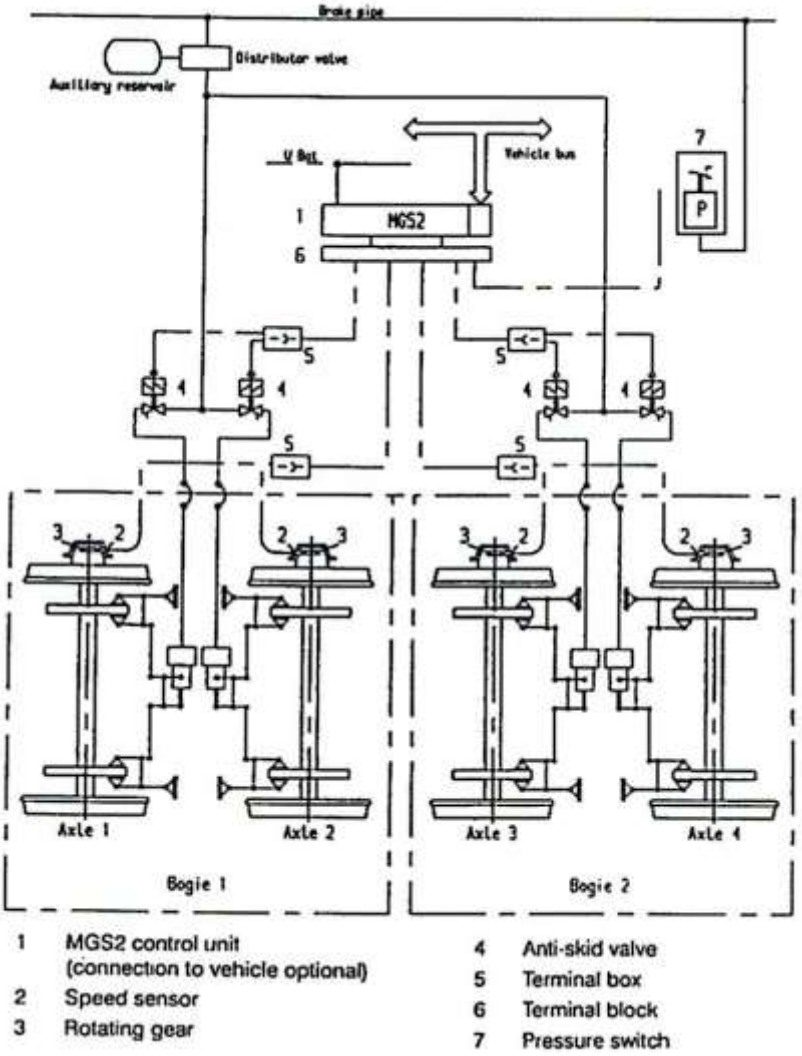


Figure: 3.24 --- Layout of a wheel slide control

Working Principle of MGS2

Control Loop

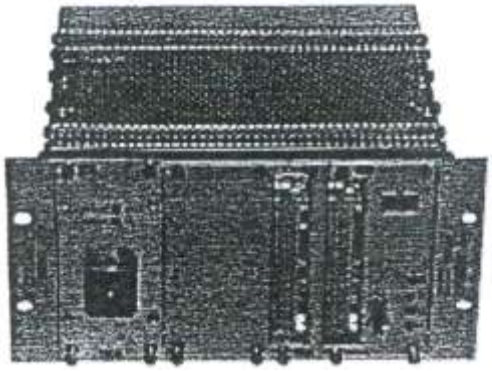
The MGS2 wheel slide control system forms a control loop through the brakes and wheel sets. The speed sensor detects the speed of the wheel without physical contact and sends a proportional frequency signal to the control unit. The control unit evaluates the frequencies from all of the vehicle‟s speed sensors and generates signals enabling the anti-skid valve to control the brake cylinder pressure.

The control loop adjusts the brake cylinder pressure to the instantaneous wheel–to–rail adhesion, keeping the wheels within their optimum range to slip and ensuring maximum possible brake force transmission.

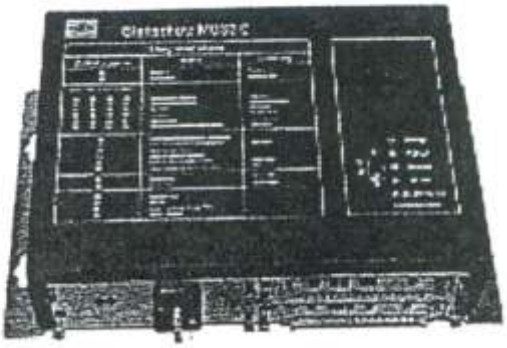
MGS2 Control Unit

Demands for maximum flexibility have led to the development of MGS2 control units in a modular 19” system. All the boards in the control unit conform to Euro-card format.
The half-19” rack for the standard version of the control unit contains the ESRA boards MB04, EB01 and a power board PB.

MGS2 Series Control Units



MGS2 –C with the MMI in the cover



MGS2 in a half – 19’’ rack

Power Board

The power board is housed in a closed box. Its front panel has two yellow LEDs indicating the operating state. The battery voltage is delivered through a front panel connector.

The power board supplies all the voltages for powering the boards, actuators and sensors. A 24V source is used to power the anti-skid valves from the MGS2 control unit.

If the vehicle is left to stand idle for any length of time, the MGS2 control unit can be switched over to a “standby” mode of low primary current consumption (standstill sleeper mode). The unit is reactivated by a pressure switch at a pre selected level in the brake pipe.

Boards MB04 / MB03

Wheel slide control - i.e. acceleration and slip control - is implemented entirely on board MB03 or MB04. MB03 contains all the electronic peripherals for individual wheel slide control at up to four wheels or wheelsets. The anti-skid valves are powered by 24V from

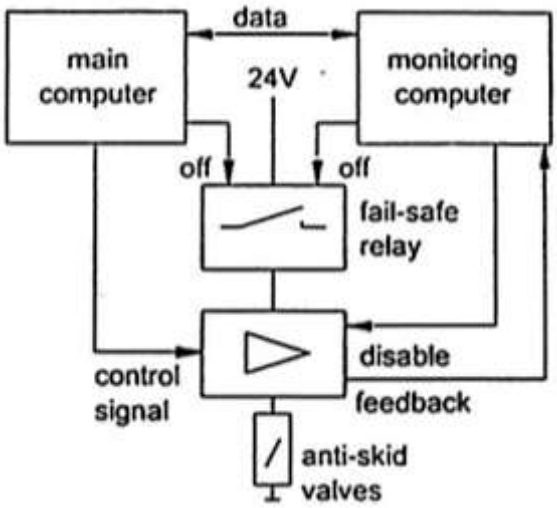
board MB03. The only difference between boards MB03 and MB04 is that MB04 has a man-machine interface (MMI) integrated in its front panel.

Features of Boards MB04 / MB03

- Microcontroller for the main computer.
- Second microcontroller for monitoring and fail-safe tasks.
- Four configurable input circuits for the speed sensors.
- Short circuit–proof feeders to power the speed sensors.
- Four input circuits for analog frequency sensors (voltage or current input)
- Eight semiconductor output stages for four anti-skid valves with two magnets each.
- Two mechanical relays to cut off the magnet valve for safety in response to a malfunction.

Fail-Safe Functions

- ➢ The monitoring computer supervises the activation times of the power output stages.
- ➢ Both computers are monitored reciprocally for hardware failures.
- ➢ Both computers cut off the output stages in two groups of four outputs each in response to malfunctioning.



Monitoring by a second processor

Diagnostic Functions

- ❖ The main computer monitors the switch outputs for short-circuits and open circuits.
- ❖ The speeds sensors are monitored for short-circuits and open circuits. Sensor power is cut off automatically in response to short-circuiting.

Man-Machine Interface

MGS2 has a man-machine interface (MMI) integrated in its front panel, whereas MGS2-C has one fitted in the housing cover.

The MMI peripherals comprise

- A 9-pin Sub-D female connector for the RS232 interface (to connect a terminal).
- A 4-character alphanumeric display, and
- Four control keys.

Board EB01

EB01 is an extension board in the MGS2 control unit. It provides digital inputs and outputs which are utilized for supplementary functions such as door control.
Features of the extension board:

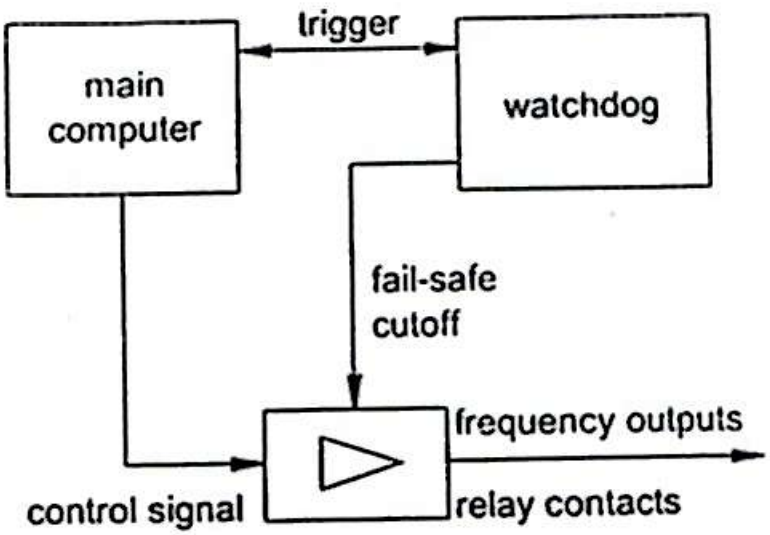
- Microcontroller serving for the main computer.
- Watchdog function.
- Eight digital inputs, galvanically isolated from MGS2 potential, the outputs and one another. Two of the inputs can be configured as frequency inputs via the software.
- A signal can be generated from up to four binary inputs to switch over the power board from "standby" mode to "normal operation".
- Eight relay outputs, galvanically isolated from MGS2 potential, the inputs and one another. Four of the relays can be used as both make and break switches. The other four have just a make contact function.
- Two galvanically isolated frequency outputs.

Fail-Safe Function

- The watchdog monitors the main computer for hardware failures.
- The outputs are switched off in response to a fault or failure.

Diagnostic Function

- The states of the relays are monitored by the microcontroller through feedback contacts.



Monitoring by the watchdog

Specifications (MGS2 standard control unit)

Speed sensors inputs	Number	4(configurable for voltage or current sensors
	Input frequency	1 Hz – 10 kHz
	Max. speed	450 km/h
Analog sensor inputs	Number	4 (configurable as voltage or current inputs)
	Input voltage	0 V – 12 V
	Input current	0 mA – 25 mA
Binary inputs	Number	8 (2 being configurable as frequency inputs)
	Input voltage	0 V – 143 V
	Input frequency	1 Hz – 500 Hz
Anti- skid valve outputs	Number	8 output stages for 4 valves
Relay outputs	Number	8
	Max. switching current	1A
	Max. switching voltage	143V
	Max. switching power	20W
Frequency outputs	Number	2
	Voltage range	0V – 143V
	Output frequency	10Hz – 1 kHz
Serial Interface	RS232	
Possible power supply voltages	24 V ± 30%, 36 V±30%, 48V ± 30%, 72 V ± 30% 110 V± 30% DC	
Maximum power consumption	About 80 W (for driving four KNORR anti-skid valves)	
No-load power consumption	About 14.4 W	
Power consumption on standby	About 1.2 W	
Safe ambient temperature	-40º C≤ T≤ + 70º C (static air, free convection)	
Rack	19”, 3 HE high, 42 TE wide	
Weight	About 3.2 kg	

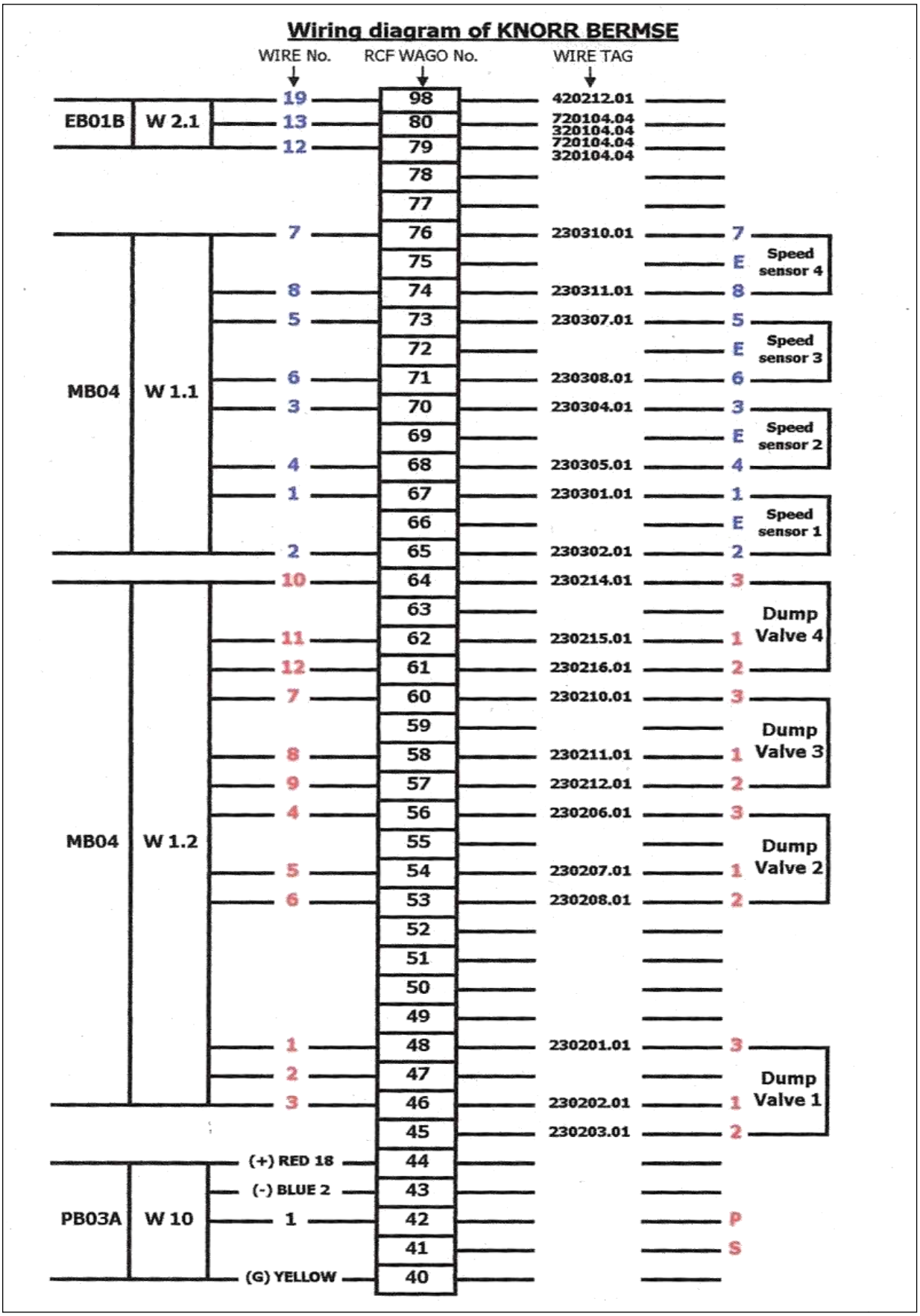
Diagnostic Functions

Test run can be started, and the fault memory read or erased through the man-machine interface (MMI) on the MGS2 control unit.

Inputs can be read, outputs written to, and system data retrieved via RS232 using a PC with the accompanying MGS2 service terminal software.

Note: For further details on diagnostic functions, please refer to OEM‟s instructions.

Wiring Diagram



3.15.5.2 Wheel Slide Control Systems (FTIL Type)

Introduction

During a constant braking force application, dependent upon the coefficient of friction available at the wheel/ rail interface, the wheel sets could start to slide. Sliding causes damage to the wheel sets (flats) and increases the stopping distance.

WSP (Wheel Slide Protection) system is able to make optimum use of available adhesion when braking, thereby optimizing the stopping distances and preventing locked (sliding) wheels and the resulting damage.

Fig 3.25 SWKP AS 20 R System

Description / Construction

The electronic unit of SKWP AS 20R system is housed in a 19" rack case. This case provides, in addition to good HF-immunity, a high resistance for shocks and vibrations.

The link between the car wiring and the electronic unit is realized by five cable connectors which are located on the front side of the case. RS 232 enables computer access for maintenance, service and system diagnosis.

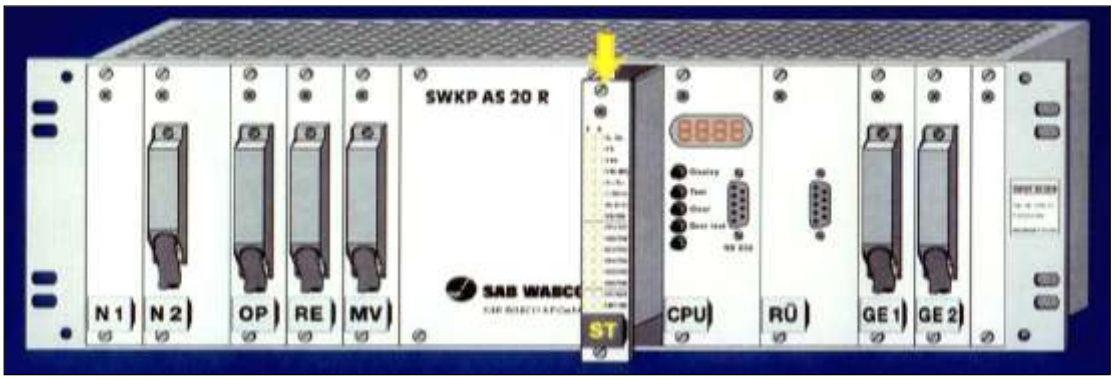


Fig 3.26.* : *Electronic Unit's Front View

Schematic Overview

Axle speed of rotation is measured and evaluated separately within a speed range of 2 to 400km/h. Axle speeds are compared with a reference speed which is a calculated value basing on the real axle speeds. The comparison between these speed signals determines

whether or not an axle is about to enter in to a slide mode. The axles speeds are measured via speed sensors and phonic wheels, all located at the axle ends. Solenoid valves (Dump valve) are connected into the brake piping close to the brake cylinders but mounted on the underside of the car body. These valves control the increase and decrease of the air pressure in the brake cylinders to assure the optimum pressure in the brake cylinders and maximized braking for the prevailing wheel/ rail interface conditions, and thus prevent sliding from occurring.

The dump valve is controlled by a 24 V nominal voltage from an internal power supply. The dump valve drive circuits are bipolar i.e. each positive and each –ve wire has its own amplifier; all amplifiers are monitored by hardware watchdog circuits to fulfill the safety requirements. Watchdog circuits supervise the correct switching of the amplifiers, if a malfunction occurs it disconnects them.

Internal Modules Function

The SWKP AS 20 R WSP system could be separated into seven components. Figure 2 gives an overview of these modules.

- Power Pack N1
- Power Pack N2
- 8 Optocoupler inputs
- 6 relay output, 2 Semiconductor outputs
- Status Display
- Solenoid amplifier
- GE module.

For further details of these modules, please refer to OEM,s manual.

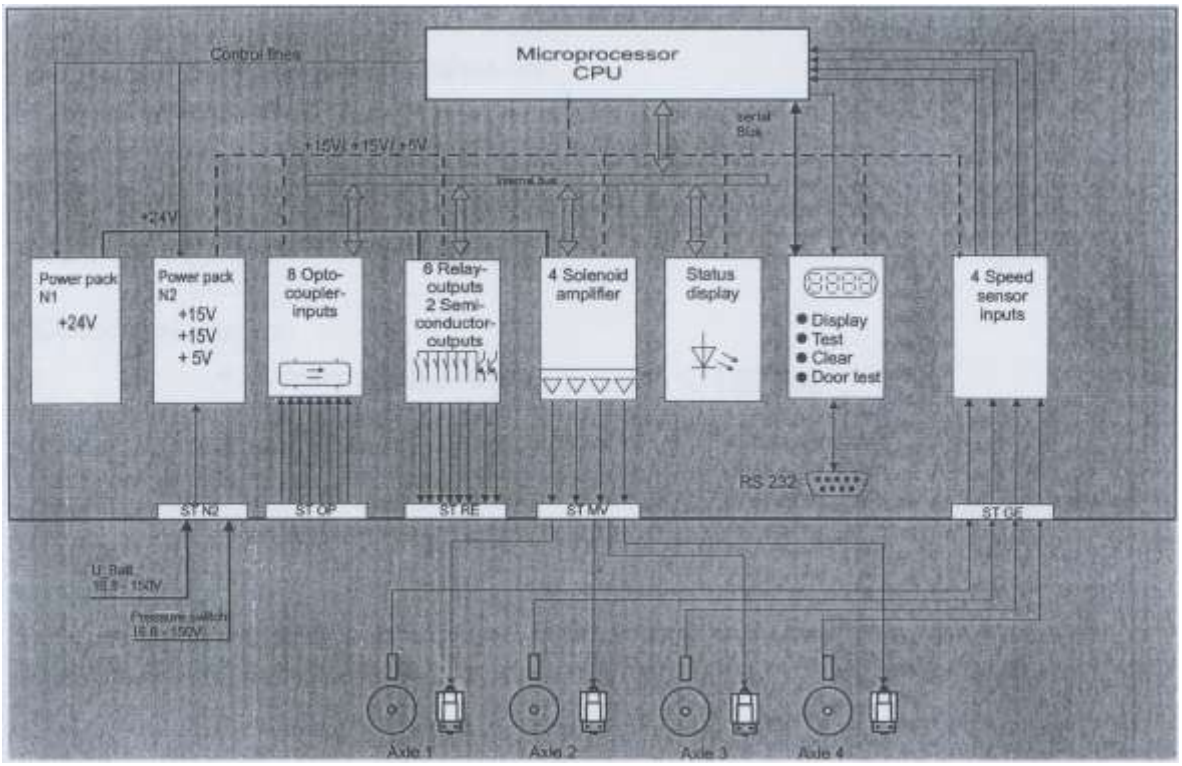


Fig.3.27: Components Overview

Push Button function of the CPU front panel

Push – button 1: Diagnostic of Faults

If the code different to 99 (95 or 72 or 73) or the system was switched off, the CPU can switched on and display the Faults by pressing the push-button 1 for at least 3s and the following functions take place:

- Indication *"88"* for 3s (7-segment LED test)
-Indication of all faults in a sequence of 3s

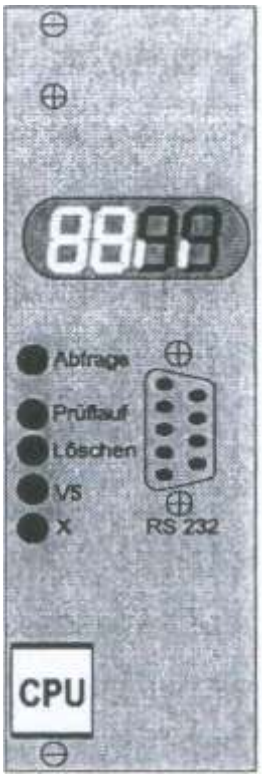


Fig 3.28 : CPU Front Panel

Push-button 2: Test

Checking of the WSP-System is performed by switching on the system (in case it was switched off) or in standstill by pressing the push-button 2 (Test) for at least 3s. The indication *"89"* appears and the following function takes place:

All brake cylinders of axles 1-4 are vented in succession. Starting with axle 1 the correct alignment of the dump valve and speed sensor should be checked again at this stage. Fig. 5 shows the connection between the venting process of the dump valves and the modulation of the light indicator of the speed sensor. The correct alignment of valve and sensor is essential for correct function of the SWKP AS 20 R wheel slide protection system. Failure to respect this will result in inaccurate axle speeds being measured and hence false pressure values are set in the dump valves.

Push-button 3: Clearing of the Failure memory

By pressing the push-button 3 for at least 3s the following function take place:

- Indication of "cLr"
- Clearing of all historical faults

Push-button 4: Door test

Checking of the Door-control is performed by switching on the system (in case it was switched off) or in standstill by pressing the push-button 4 for at least 3s. The indication "89" appears and the following function takes place:

- Relay contact "Device on" open and
- Relay contact "Door control" closed for 1 min.

Push-button 5: X/ Kilometer counters

By pressing the push-button for at least 3s the distance will be shown on the display. The distance is a value with 8 positions and is divided in two parts. At first the most significant part is shown on the display followed by the least significant part.

Example: First displayed part: 0013
Second displayed part: 5620
Equals to a distance of: 135620 km

The kilometer counter can only by adjusted or reset via RS232 interface by an additional PC software supplied by SAB W ABCO KP GmbH.

Remark: The distance is calculated with the average wheel diameter.

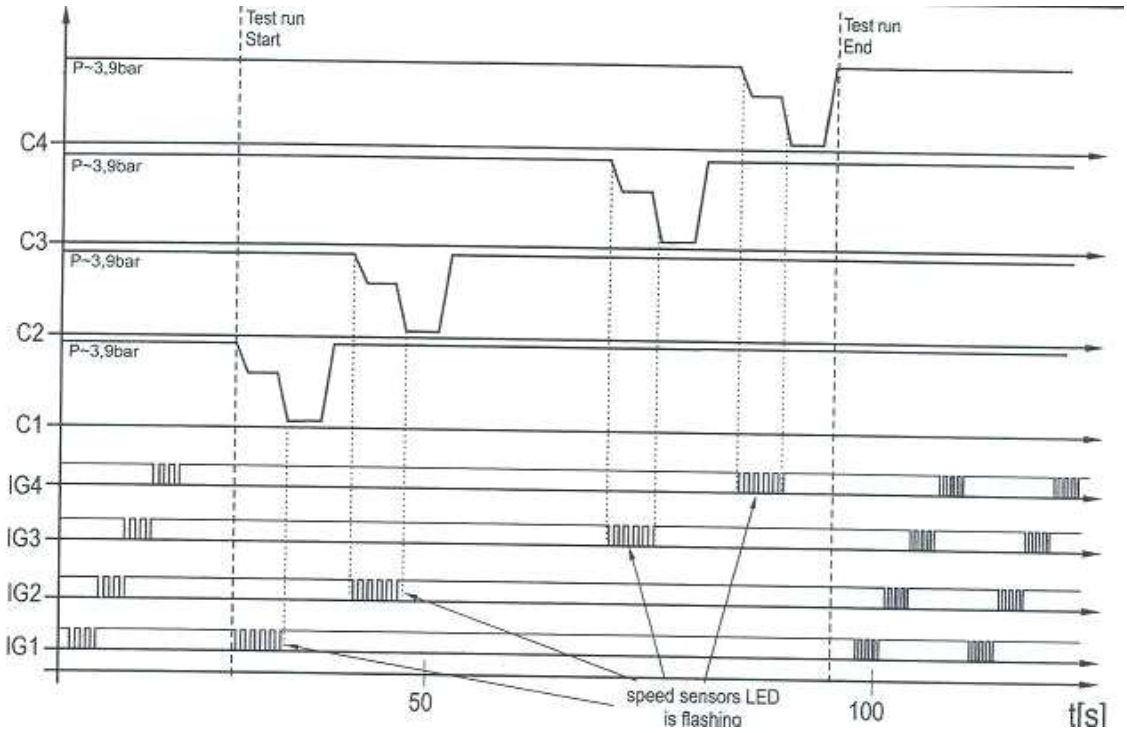


Fig 3.29: Time taken for valve control and speed sensor modulation during a test run

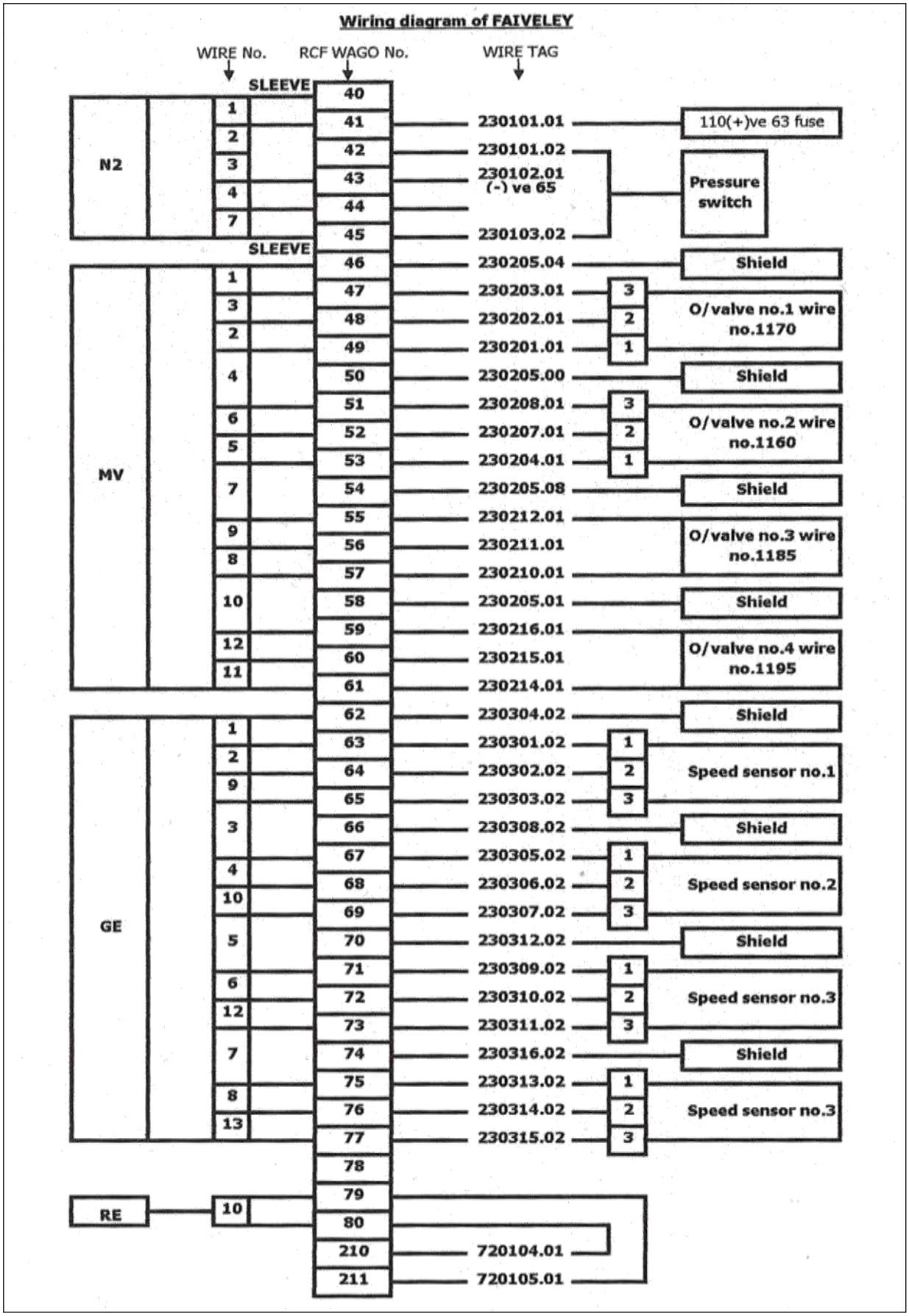
Relay-Test

A test of the relay outputs can be activated via the push buttons on the CPU:

Action	**Remarks**
1. Press buttons 1, 3 and 5 until display shows: "0000".	Now you enter the hardware-test-mode.
2. Press button 1 until display shows "0001".	
3. Press Button 5 until display shows "r0_1".	*r0-1* means that relay number 0 is energized now. You can see the LED of RE1 on the status display.
4. Press Button 5 to test the other relays. The Display will show: "r1-1" ... "r2_1" ... "r3_1" etc. "H0_1" and "H1_1" are the semiconductor outputs.	Only the relay that is displayed at the moment is energized. The other relays are switched off. When a relay is energized, you can check the function in combination with the car equipment.
5. To get back into normal WSP-Mode press the buttons 1 and 2 for a short time and release. The Display shows "99".	When you can't get back by pressing this buttons, please switch off the supply voltage of the WSP system and switch on again. Now the Display shows "99".

Attention: *When the relays are energized, the accompanying function in the coach will start to work. Be sure that nothing can be damaged and no people can be hurt.*

Wiring Diagram:



Components

WKP MV 20 Dump Valve

SWKP MV 20, dynamic 3/2 dump valve adjusts the brake cylinder pressure *to* maximize the braking effort for any given wheel / rail interface coefficient of friction.

The dump valve includes two independent coils housed in the coil body. This allows three-point regulation of the brake cylinder pressure.

If none of the valve coils is powered the braking cylinder is pressurized. If the inlet valve coil is powered, the pressure in the braking cylinder is held. Only if both coils are powered the pressure may decrease.

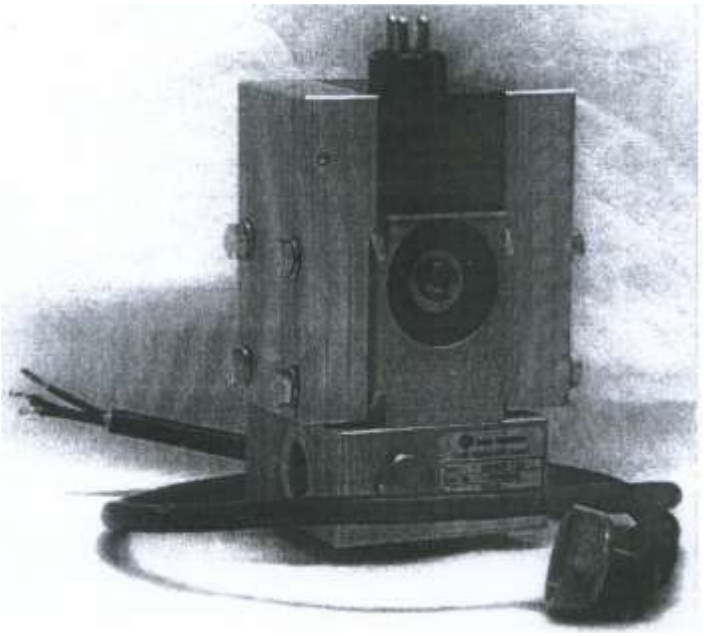


Fig 3.30 Dump Valve

Inlet solenoid BV	Outlet solenoid EV	Braking cylinder‟s pressure C
0 Volts	0 Volts	Increasing/ Decreasing
24Volts	0 Volts	hold
24Volts	24Volts	Decreasing

Technical Data

Medium	Compressed air
Operating Pressure	Max. 8,5 bar
Operating Temperature	- 40°C - + 80°C
Voltage	24 Volt ±3%
Nominal Power	8 Watt
Cycle time	ED 100%
Insulation class	F
Test norm	EN 50 155

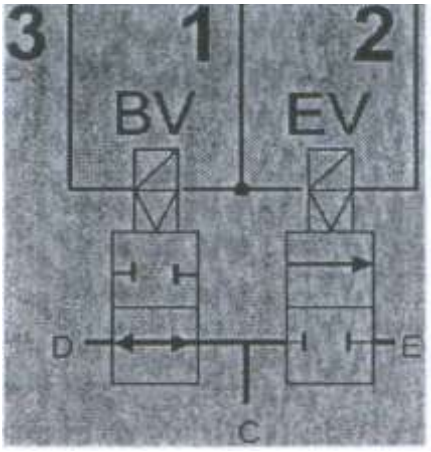


Fig 3.31 Valve symbol

IG 20 Speed Sensor

The sensor system for the SWKP AS 20 R is based on a non-contact counting of revolutions/ min. The SWKP IG 20 speed sensor ensures in conjunction with the phonic wheel, wear free functioning due to the gap of A = 1.5 ± 0.5 mm. Figure shows a speed sensor mounted in the axle end cover.

A special feature of the speed sensor is the in-built optical multi-function indicator that is visible on the sensor housing. This fibre optic light indicator has the following functions:

- When the SWKP AS 20 R is switched on the light is illuminated. From the track side it can be seen whether the WSP system is switched on or off.
- The speed sensors are tested cyclically for correct functioning. When the vehicle is stationary and the speed sensors are checked the optical indicator is switched on and off ('modulated'). This shows that the microcontroller has carried out its test properly and that the link with the speed sensor is correct.

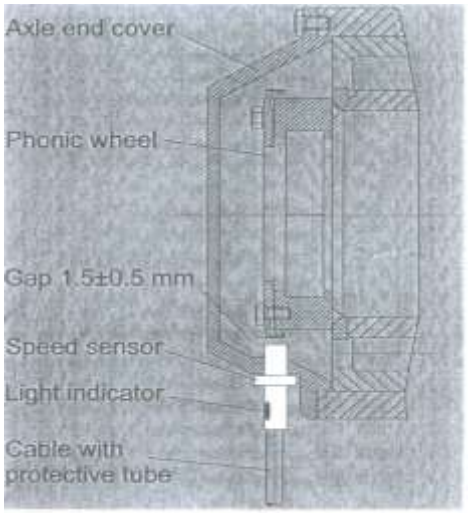


Fig 3.31: Mounted Sensor

The indicator signals the correct alignment between the solenoid valve and the corresponding speed sensor.

This function is particularly important at the initial startup or during maintenance work, when the wiring is disconnected and reconnected. At the manual test run's start, the solenoid valves are controlled and the corresponding speed sensors are switched on and off. During the valve tests the acoustics of the valve and the optical indicator are harmonized with the brake cylinder dumping.

Fig 3.32 SWKP IG 20 Speed Sensor

Technical Data

Supply Voltage (U_B)	8 Volts -15 Volts DC
Current Consumption	Less than 9 mA
Output Voltage	High – U_B-1,5 Volts, Low = 1Volts
Output Current	8mA
Form of Output signal	Rectangle
Frequency range	$1H_Z$-$12KH_Z$
Gap between sensor & phonic wheel	0.9 to 1.4 mm
Ambient temperature	40ºC - +100ºC
EMC-Resistance	According to EN 50121-3-2
Test - Norm	EN50 155

Phonic Wheel

A phonic wheel is installed on one end of each axle. The phonic wheel is a toothed wheel which modifies the internal inductance of the adjacent sensor. This modification is evaluated as axle speed.

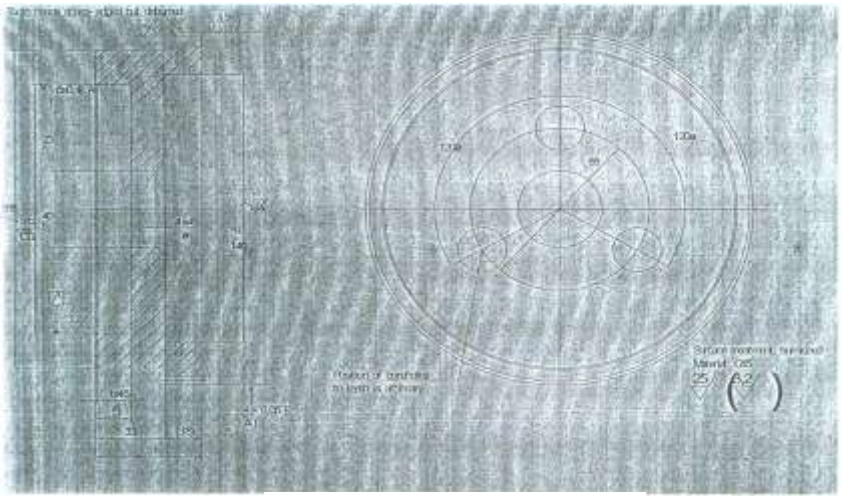


Fig 3.33 Phonic wheel

Technical Data

Electronic Unit SWKP AS 20R	
Supply Voltage:	16, 8 -150 Volt DC
Nominal Voltage:	24 Volt DC
Voltage Ripple:	10 % of nominal voltage
Current Consumption:	5 Ampere max., 0. 3 Amp min.
Load on Relay Contacts:	0.5 Ampere /150 Volt
Fuse:	10 Ampere mT
Ambient Temperature:	- 40 °C - +80°C
Protection class:	IP20
Mounting Position:	Horizontal
Weight:	4.5 kg
Speed range:	2 - 400 km/h
Service - Interface	RS 232

Maintenance and Service

Electronic Unit

The electronic unit does not require any maintenance: All internal and external components are continuously checked by the self test routine, so that no manual inspection is necessary. Only the lifetime of the internal battery of the CPU – board is limited to 8 years. After that time, the battery should be replaced to keep the functionality of storing process data in the internal RAM. Further functions of the WSP – System are not affected by an empty battery.
During the regular car inspection a visual check of the electronic unit should be carried through. In this case one has to take care that code “99” on the displays is indicated. In case of showing code “99” a finishing test run is to be carried out.

Solenoid Valve

The solenoid valve and the connecting piping between the distributor and the brake cylinder must be checked regularly for damages and leakage.

The function of the valves can be tested during a test run:

Test runs are initialized by pressing the push button 'Test' located on the electronic unit; the display code reads '89' . The continuous modulation (switching on/ off) of the speed sensor light indicator, located in the sensor housing will be interrupted then.

Beginning with Axle 1, the brake cylinders are briefly exhausted while the associated speed sensor light indicator is switched on/off (modulated). The speed sensors and their associated solenoid valves must be connected correctly on initial installation, as this provides correct measurement data. The time sequence of a test run is shown in Figure showing supply and exhaust of the valve and the modulation (switching on/ off) of the associated light indicator of one axle.

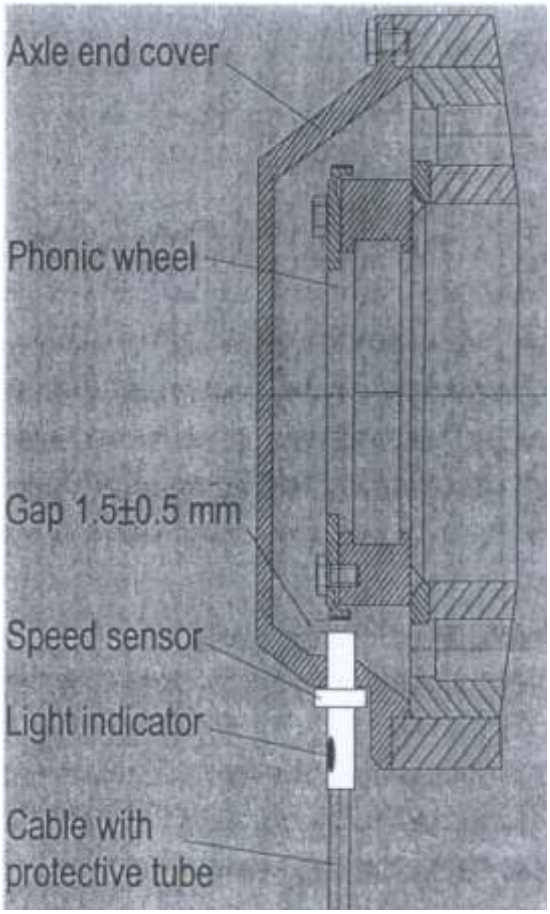


Figure* 3.34: *Speed sensor mounting

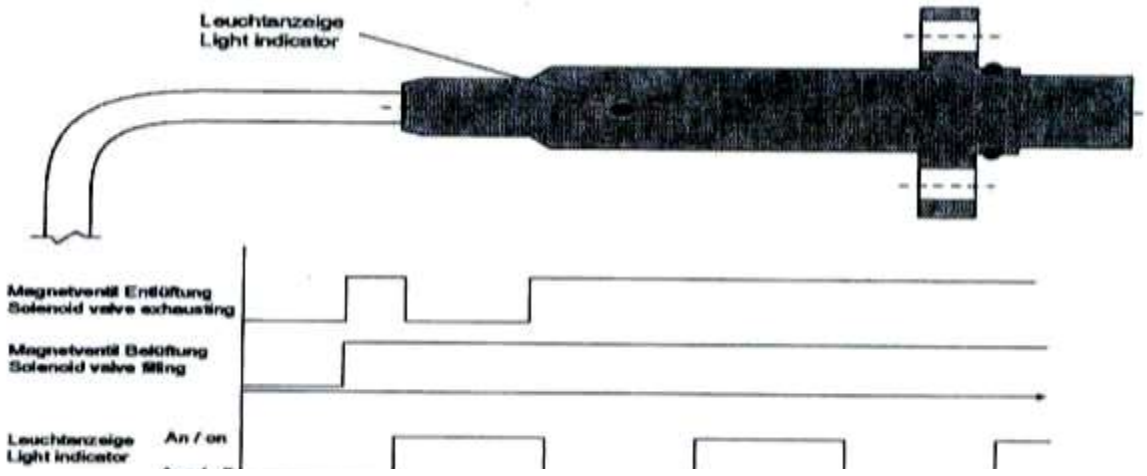


Figure 3.35 Speed sensor housing /Test sequence of one axle

Illustration shows the temporal succession of entire test run with all four axles. Before the beginning of the test run and after its completion, the modulation according to standard of the control indicators is to be recognized: it goes through cyclically all four axles and begins then again. *SAB WABCO KP GmbH recommends* to *run a system test on time per month* to *be sure that the system is ok.*

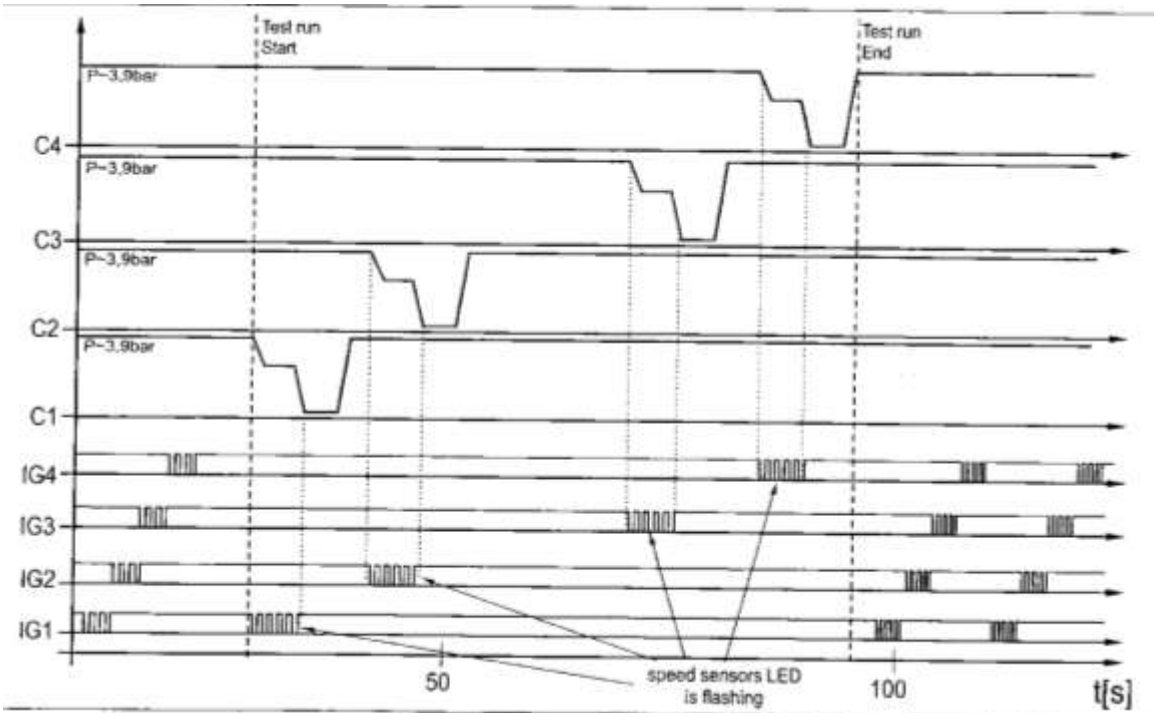


Fig 3.36 Time Sequence of an entire test

It is essential that all pipes are cleaned after initial installation to ensure all kinds of dirt particles are removed.

Within a maintenance interval of 4 *years (recommendation of SAB WABCO* KP *GmbH), the following consumables have* to *be changed:*

1. Visual check of the solenoid valve for external damages.
2. Disassembling of valve's body from car
3. Disassembling of filter (pos. 8), cleaning and mounting again
4. Following parts as per assembling drawing "part drawings no. 1/604588 /590" have to be changed and cleaned, independent on their wear condition:

Spare parts list dump valve

Type No.	Component name	Quantity	Position
	Valve body 1/ 604 588		
1/604575	Gasket	1	4
1/604576	O – Ring	2	7
1/604 584	Diaphragm	2	9
1/604609	Spring	1	11
1/604 577	O – Ring	1	12
1/604600	O – Ring	4	16
1/604 602	Magnet tube with Anchor	1	19
1/604603	Magnet tube with Anchor	1	20
1/604 599	O – Ring	2	21
1/604578	O – Ring	2	22
	Valve bracket 1/ 604 590		
1/ 604 570	O – Ring (Pressure sensor)	**1**	

Remark: All components, listed in the table above, are available with ordering code 1/604 620 at SAB WABCO KP GmpH.

5. Solenoid valve body is to fit onto the existing test bracket and functionality test as per test instruction PV1604588/590 should be carried out.

6. Dump valve body assembling on the car.

7. Test run.

Parts list for dump valve bracket 1/604 590:

Quantity	**Spare Part Description**	**SWKP Part number**
1	Empty bracket	1/604589/001
1	Brass screw for pressure sensor connection	1/604647
1	O-ring for brass screw	1/604570
1	Choke Ø 9 mm	1/604 573/002
1	Choke Ø 6 mm	1/604573/001
2	Washer	4/603024/006
2	Screw M8 x 50	4/603025/002

Speed Sensor

The speed sensor themselves in general do not need any maintenance as it is continuously checked by the electronic unit and any fault is reported.

During the regularly inspection of the car a visual check of the speed sensor should be carried through. Following steps should be done:

1. Visual check of the sensor's damages, in particular:

   - Sensor head

   - Damage of protection hose

   - bending of the protection hose

2. Checking of the correct assembling of the sensor's (distance to the phonic Wheel)

3. Function check of light indicator while WSP Electronic is switched on modulation)

4. Test run as per “part II Installation and Start – Up” chapter 3.

Spare parts for the speed sensor please order as special request.

Phonic Wheel

The phonic wheel does not need any maintenance at all when operated under normal conditions.

Fault Diagnosis and Error Management

The SWKP AS 20 R WSP System's fault diagnosis takes place via the electro nic unit's 4- digit - display. Normal operation is indicated on the display by the code '99'.

When an error occurs, the displayed code will change from '99'. Exceptions to this are test run code '89' and display test code '8888'.

To distinguish between a single axle and more than one axle being impaired by a failure, the WSP displays differing codes: Code '72' announces failures which concern only one axle, code '73' reports failures concerning more than one axle.

If Code 70 or 71 is shown there is a fault in WSP device electronics in the area of the relay drive.

If a failure has occurred, more information about it can be obtained by pressing the, display' button - the failure code will be displayed.

The following table contains code display failure code, failure cause and actions to correct the fault.

Failures are divided into two classes: permanent failures and intermittent, sporadic failures, which failure codes are stored by the SWKP AS 20 R unit.

Failure code in display	**Meaning**	**Action to be taken**
10	Hardware Watch-dog MV1triggered	Replace MV card
11	Short circuit or interruption of speed sensor of axle 1.	♦ Check red light indicator of speed sensor. Perhaps change of speed sensors with another axle to check. ♦ Check wires from WSP electronic to speed sensor if there is any short circuit or interruption ♦ Check terminal connections and SUB-D-cable GE from terminal to WSP electronic. ♦ Replace GE-board to check. ♦ Replace
13	Short circuit of solenoid valve axle 1.	♦ Disconnect dump valve cable and check dump valve for short circuit. ♦ Check cable from terminal to dump valve junction box for short circuit. ♦ Check SUB-D cable MV for short circuit ♦ Replace MV card ♦ Replace CPU card.
14	Interruption of solenoid valve axle 1.	♦ Disconnect dump valve cable and check dump valve for interruption. ♦ Check cable from terminal to dump valve junction box for interruption. ♦ Check SUB-D cable MV and terminal for interruption Replace MV card ♦ Replace CPU card ♦ Replace MV card.
20	Hardware Watch-dog MV2 triggered.	Replace MV card.
21	Short circuit or interruption of speed sensor of axle 2.	♦ Check red light indicator of speed sensor. Perhaps change of speed sensors with another axle to check. ♦ Check wires from WSP electronic to speed sensor if there is any short circuit or interruption ♦ Check terminal connections and SUB-D-cable GE from terminal to WSP electronic. ♦ Replace GE-board to check. ♦ Replace CPU-Board to check.

Failure code in display	Meaning	Action to be taken
23	Short circuit of solenoid valve axle 2	♦ Disconnect dump valve cable and check dump valve for short circuit. ♦ Check cable from terminal to dump valve junction box for short circuit. ♦ Check SUB-D cable MV for short circuit ♦ Replace MV card ♦ Replace CPU card
24	Interruption of solenoid valve axle 2	♦ Disconnect dump valve cable and check dump valve for interruption. ♦ Check cable from terminal to dump valve junction box for interruption. ♦ Check SUB-D cable MV and terminal for interruption ♦ Replace MV card ♦ Replace CPU card
30	Hardware Watchdog MV3 triggered.	Replace MV card
31	Short circuit or interruption of speed sensor of axle 3.	♦ Check red light indicator of speed sensor. Perhaps change of speed sensors with another axle to check. ♦ Check wires from WSP electronic to speed sensor if there is any short circuit or interruption ♦ Check terminal connections and SUB-D-cable GE from terminal to WSP electronic. ♦ Replace GE-board to check. ♦ Replace CPU-Board to check.
33	Short circuit of solenoid valve axle 3	♦ Disconnect dump valve cable and check dump valve for short circuit. ♦ Check cable from terminal to dump valve junction box for short circuit. ♦ Check SUB-D cable MV for short circuit ♦ Replace MV card ♦ Replace CPU card
34	Interruption of solenoid valve axle 3.	♦ Disconnect dump valve cable and check dump valve for interruption. ♦ Check cable from terminal to dump valve junction box for interruption. ♦ Check SUB-D cable MV and terminal for interruption Replace MV card ♦ Replace CPU card ♦ Replace MV card.

Failure code in display	Meaning	Action to be taken
40	Hardware Watch-dog MV 4 triggered.	Replace MV card.
41	Short circuit or interruption of speed sensor of axle 4.	♦ Check red light indicator of speed sensor. Perhaps change of speed sensors with another axle to check. ♦ Check wires from WSP electronic to speed sensor if there is any short circuit or interruption ♦ Check terminal connections and SUB-D-cable GE from terminal to WSP electronic. ♦ Replace GE-board to check. ♦ Replace CPU-Board to check.
43	Short circuit of solenoid valve axle 4.	♦ Disconnect dump valve cable and check dump valve for short circuit. ♦ Check cable from terminal to dump valve junction box for short circuit. ♦ Check SUB-D cable MV for short circuit ♦ Replace MV card ♦ Replace CPU card.
44	Interruption of solenoid valve axle 4.	♦ Disconnect dump valve cable and check dump valve for interruption. ♦ Check cable from terminal to dump valve junction box for interruption. ♦ Check SUB-D cable MV and terminal for interruption ♦ Replace MV card ♦ Replace CPU card.
70/71	Internal relais test fault.	Replace GE card for testing and if necessary permanent Replace CPU card for testing and if necessary permanent When both replaces don't bring success, send complete device to SWKP.
72	Failure at one axle.	Press "Display" button to see what failure code is saved. Further information you can find at the failure code description.
73	Failure at several axles.	Press "Display" button to see what failure code is saved. Further information you can find at the failure code description.
95	Allgemeine Anzeige fur einen sporadischen Fehler.	There was a failure in the past. Press "Display" button to see what failure code is saved. Further information you can find at the failure

Failure code in display	Meaning	Action to be taken
		code description.
HF	Hardware failure.	Press "Display" button to see what failure code is saved. Further information you can find at the following failure code description.
bt	Battery failure at CPU card.	Check battery at the CPU card. Replace battery if the voltage is below 3V.
Pr	Processor failure.	Replace CPU card
EP	EPROM failure.	Replace the EPROM. Take care, that the EPROM has included correct software version. If you are not sure, contact SWKP. When the failure is still alive, replace CPU card.
EE	EEPROM failure.	Replace CPU card.
Hd	Hardware monitor-ing failure of CPU card.	Replace CPU card
n1	24V voltage for the dump valve supply is not available.	♦ Check at ST card, if all voltages are available (four LEDs must be on) ♦ If 24V LED is off, try to replace the Nt card. If ok then replace permanent. ♦ If failure still alive, replace MY card. If ok then replace permanent. ♦ If all LEDs are on, replace CPU card.

If enhanced failure diagnosis is requested, SAB W ABCD KP, offer an optional software package for Windows™, computers, which makes failure handling easier: Via an RS232 link between SWKP AS 20 R and computer it is possible to read the device's failure archive so the generation of a documentation of the failures' frequency and times of occurrence can be easily recorded.

Table of failure Codes

Axle	Code	
1	10	Safety shut-down MV (Dump Valve)
1	11	Short circuit / interruption GE(Speed Sensor)
1	13	Short Circuit MV (Dump Valve)
1	14	Interruption MV (Dump Valve)
2	20	Safety shut-down MV (Dump Valve)
2	21	Short circuit / interruption GE (Speed Sensor)
2	23	Short Circuit MV (Dump Valve)
2	24	Interruption MV (Dump Valve)
3	30	Safety shut-down MV (Dump Valve)
3	31	Short circuit / interruption GE(Speed Sensor)
3	33	Short Circuit MV (Dump Valve)
3	34	Interruption MV (Dump Valve)
4	40	Safety shut-down MV (Dump Valve)
4	41	Short circuit / interruption GE (Speed Sensor)
4	43	Short Circuit MV (Dump Valve)
4	44	Interruption MV (Dump Valve)
	70/71	Relay failure
	72	WSP disturbance, one axle
	73	WSP disturbance, several axle
	HF	Global hardware failure
	Pr	Processor
	EP	EPROM
	EE	EEPROM
	Hd	Hardware watchdog
	Bt	Onboard battery failure or low voltage
	n1	24 V Failure
	88888	Segment test
	89	Test run
	95	Intermittent fault
	99	Good indication

Note: For WSP equipment, schedules should be followed as recommended by OEM.

Care & Precautions to be Taken for Proper Functioning of WSP:-

a. Use of non-standard fasteners for fitment of Phonic wheel on axle.

b. Speed sensors are missing/open circuit.

c. Speed sensors' cables are not properly connected.

d. Sensor cable fitted with loose strands.

e. Dump valve leaking during brake application.

f. Junction box in broken /damaged condition.

g. Water cleaning of axle box housing.

h. Improper dump valve connection.

In above reference Railways are advised to take following action:

i. Special drive should be launched for checking of Phonic Wheel assembly in D3 Schedule.

ii. M8 size screw to IS 1367 pt.iii Class 10.9 along with spring washer to the IS 3063 type-B should be used for securing phonic wheel. LOCTITE 243 or equivalent glue should be used to ensure rigid connection between internal and external thread.

iii. Non-standard fasteners if found during check, should be replaced immediately.

iv. The Phonic Wheel screws should be tightened with 21 N-m torque.

v. The clearance between the phonic wheel and speed sensor should be 0.9 to 1.4 mm in case of KB make & FTIL make WSP. This gap should be checked in D3 schedule or whenever required.

vi. The phonic wheel and speed sensor should be procured through OEM „s/ OEMs' approved Sources only. Brake system manufacturers, presently M/s Knorr Bremse and M/s Faiverely are OEM of this item.

vii. Railways must ensure that Air Brake System/ WSP is maintained as per OEMs' Maintenance Manual.

3.15.6 Speed Sensor

The G16 speed sensor scans a ferromagnetic rotating gear (tooth module 2) that is centered over the axle. It works without physical contact and does not wear. The air gap between the rotating gear and sensor is 0.4 to 1.4 mm.

Rotating gear / Speed sensor

The speed sensor G16 operates in the range between 0 Hz and 4 kHz. The frequency of the digital current signal is directly proportional to the circumferential speed of the rotating gear.

The MGS2 control unit monitors the speed sensors for correct operation at both standstill and on the move.

The G16 pulse generator consists essentially of a magneto resistive pickup to which is connected an electronic interpreter. Both items are hermetically sealed inside an aluminum die casting.

Working Principle

The pulse generator senses the teeth and gaps on a rotating, ferromagnetic gear wheel. The magnetic field changes are converted into electric signals by a pickup.

A current of 7mA or 14 mA is applied to the output via an electronic interpreter. The axle speed is ascertained from the number of pulses per unit time.

Maintenance

The G16 pulse generator works without wear or contact, and therefore requires no special maintenance. However it needs checking for good external condition and proper operation at regular intervals.

Troubleshooting

Problem	**Cause**	**Remedy**
Speed signal missing or erroneous	Pulse generator‟s electric cable is damaged	Replace the pulse generator.
	Electric cabling in the vehicle is damaged	Replace the electric cabling
	Distance between pulse generator and rotating gear is out of specification	Check the distance and correct if necessary.
	End face of pulse generator is damaged	Replace the pulse generator.
	Electronic part of pulse generator is defective	Check electronic circuitry against the applicable KNORR-BREMSE Test Instructions. If necessary, replace the pulse generator.

3.15.7 Anti-Skid Valves (GV 12- ESRA)

The anti-skid valve works as an actuator in the anti-skid control circuit. The anti-skid valve is controlled by the MGS 2 control unit. The anti-skid valve may be operated to reduce the brake cylinder pressure in steps or to increase it again, up to the level set by the distributor valve.

Installation in the Brake System

The anti-skid valve is pneumatically connected at D to the distributor valve and at C to the brake cylinder to be controlled. The electrical connection with the electronic control unit is established through a three-core line. Provisions for disconnection with a three-pin plug are made at the anti-skid valve. The two wires II and III are provided for driving the two valve magnets for venting or charging control while wire I serves as the common return line.

Design

The anti-skid valve comprises essentially a valve housing with two switching diaphragms, a twin valve magnet, two side plates for the connection of the valve magnet with the housing, and a valve bracket.

The housing includes two valve seats (V_D and Vc). Either valve seat is adapted to be opened or closed, respectively, by one of the diaphragms.

The D-diaphragm is provided to open or shut off the path from the D-chamber (from the distributor valve) to the C-chamber (to the brake cylinder).

The C-diaphragm is provided for establishing the communication of the C-chamber with O (atmosphere).

The twin valve magnet is composed of two 2/3-way solenoid valves (VM1 and VM2) having coils accommodated in a common plastic housing. The pins for the electric connection are integrally cast on the housing.

In the non-energized condition the force of the armature springs urge the two armatures into a position in which the outer valve seats are sealed while the inner valve seats are open.

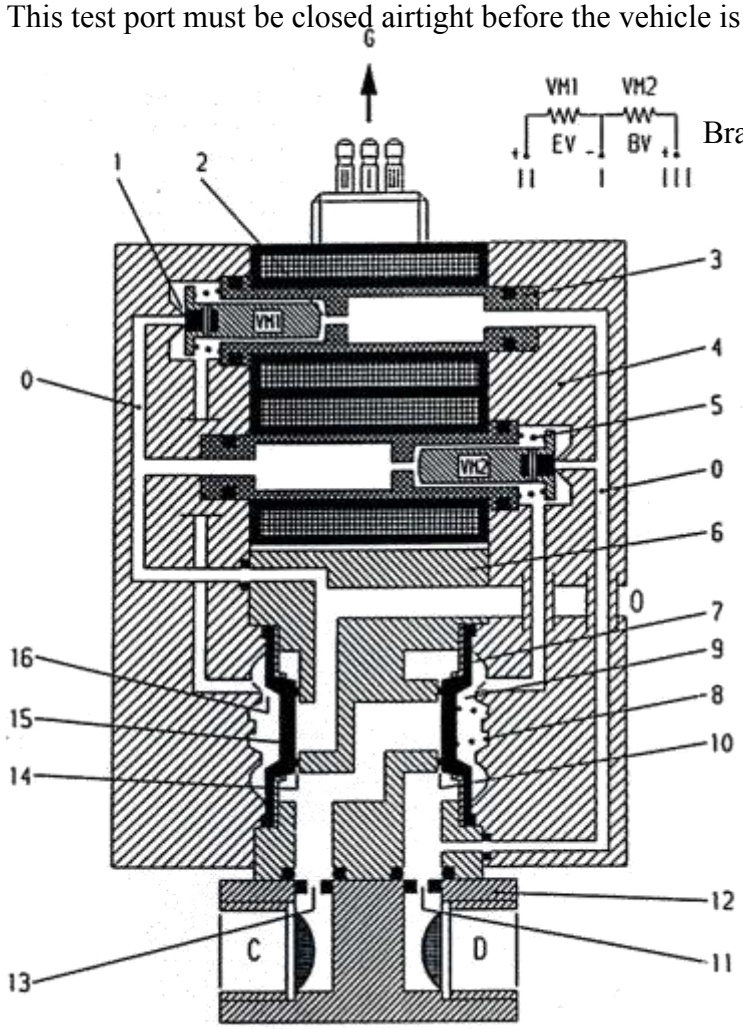
The two side plates enclose the control chambers S_D and S_C for the diaphragms and the conductors leading to the twin valve magnet

The valve is screw-fastened on a valve bracket which presents the two fitting threads for the D- and the C-pipes. With the valve being disassembled from the valve bracket the nozzles d_D and d_C are easily accessible.

Installation in the Vehicle

The anti-skid valve must be installed at the coach body with its venting opening facing downward. The feed pipe to the brake cylinder to be controlled should be short and un throttled so as to minimize delay times and leakage, as far as possible

The anti-skid valves have a test port on the valve bracket for measuring the C-pressure. This test port must be closed airtight before the vehicle is placed in service.



Anti – Skid Valve GV12….
Brake released (valve unpressurized)

Figure3.37: Anti – Skid Valve GV 12 …..

1. Outer valve seat
2. Inner valve seat
3. Twin valve seat
4. Side plate
5. Armature spring
6. Housing
7. Diaphragm D
8. Conical spiral spring
9. Control chamber S_D
10. Valve seat V_D
11. Nozzle d_D
12. Valve seat V_C
13. Nozzle D_C
14. Valve Seat V_C
15 Diaphragm C
16. Control chamber Sc

C to the brake cylinder
D to the distributor valve or the pressure transformer
G .. to the anti-skid control unit

3.15.8 Brake Pipe Accelerator Valve

Introduction

Brake Pipe accelerator Valve provides rapid venting of the brake pipe only during emergency brake applications. It is designed so that it is not activated during normal braking functions. This valve is connected to the brake pipe on each coach through a 1" isolating cock, normally kept open.

Construction

The main body is cast from aluminum alloy and contains the housings for the various Valves and ports. The Valve inserts, joints, O rings and diaphragms are from synthetic rubber. The Valve stems and the sliding seat are made from stainless steel. The vent port is protected by a rubber flap.

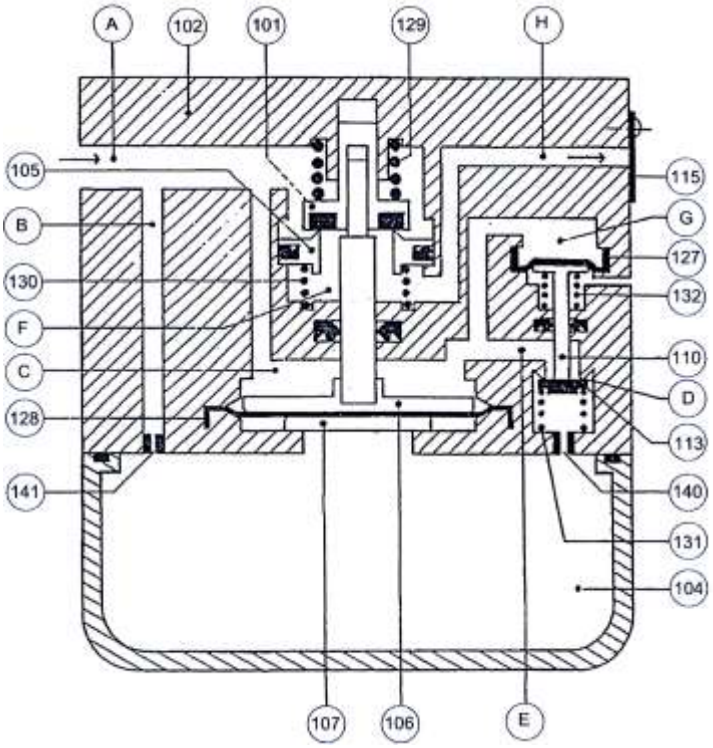


Fig3.38: BP Accelerator Valve

Operation (Refer to Fig. 3.38)

Charging

During the B.P. air charging phase, the diaphragm cap (107) is pressed against its lower stop by the brake pips pressure in chamber C, acting on the diaphragm (128).The Valve(101) is thus closed against the sliding seat(105),shutting the brake pipe off from the atmosphere vent(H).

The valve stem (110) is held in its uppermost position by the spring (132).The control volume (104) is rapidly charged by a combination of the direct connection through passage B and choke (141) and through chamber C, passage E, Valve (113)acting as a check vale and choke (140). At a brake pipe pressure of4.5 ksc, this pressure in chamber G acts on the diaphragm (127), overcomes the force of spring (132)and pushes down the valve stem (110), thus holding the lower inlet valve(113) open.

Service Braking

When the brake pipe pressure drop to 4.5 ksc during service braking, the pressure in chamber G is no longer sufficient to hold the valve stem (110) down against the spring (132) and valve (113) closes.

The bore of choke (141) is fixed such that the pressure difference on the two sides of the diaphragm (128) cannot become large enough to lift the valve stem and open valve stem assembly (101), thus ensuring the Accelerator Valve is not activated during service braking. The sensitivity and insensitivity conditions are set by the choice of the bore of the two chocks (140,141) and meet the U.I.C. requirement.

Emergency Braking

In the event of an emergency brake application, the Brake pipe pressure drops very rapidly in chambers A and C and also for a short initial period in the control volume with the air flowing through both chokes (140,141).

Valve (113) closes at a control chamber pressure of 4.5 ksc and air can now only flow out of the control volume through one choke (141). This much reduced air flow causes a large pressure difference to develop across the diaphragm (128) so that the upper pressure plate (106) is raised and the valve stem assembly (101) opened, venting the brake pipe A to atmosphere at H, via the chamber F.

The period during which the valve (101) remains open is governed by the time taken for the pressures on the two sides of the diaphragm (128) to equalize, i.e. the pressure in chamber C and the control volume. However, at brake pipe pressure of2.0 ksc, the sliding seat (105) rises to its top stop due to the action of compression spring (130), closing the valve stem assembly (101) and the brake pipe connection to atmosphere is thus closed.

Charging Surge

The valve inlet (113) remains open during a pressure charging surge and also during its fading phase. Air flows through both Chokes (104,141) and a pressure balance between chamber C and the Control Volume (104) is quickly achieve, inhibiting the operation of the Accelerator Valve during the fading phase of charging surges.

Maintenance and Overhaul

For maintenance and Overhauling of Brake Accelerator, please refer OEM‟s instructions.

ANNEXURE – A

AIR BRAKE RAKE TESTING PROCEDURE (LHB COACHES)

1. On arrival of the rake on pit line, completely drain the AR tank (125 litres & 75 litres) of all the coaches by opening the drain cock, to remove the water in air.

2. Initially, couple the BP hose of the test rig with the BP hose of the rake & then charge the BP pressure to 5.0 kg/cm^2. Keep the FP angle cock of both end power cars in close position. Check the FP gauge fitted in the power car, if the gauge does not show any pressure, the NRV of all the coaches are ok. If, FP gauge shows any pressure, the NRV of any coach in the rake is defective. In this condition, check the rake for NRV defective by taking the coaches in parts. NRV found defective in particular coach should be replaced.

3. Open all the four cocks of rake, couple BP & FP hose pipe of test rig with the BP & FP hose pipe of the rake. Charge the BP & FP to 5.0 kg/cm^2 & 6.0 kg/cm^2 respectively. After building of pressure in BP & FP, disconnect the test rig BP & FP hose pipe from the rake hose pipes & open both the angle cocks, due to which air pressure will be exhausted in atmosphere & brake will be applied. Wait for 20 to 25 minutes.

4. After 20 to 25 minutes, check the complete rake from one end. Note down the coach nos. found with release brake cylinder. Check whether, AR tank of the coach is charged or empty. If AR tanks found empty, write down Empty AR on the respective coach. If found charge, pull manual release of DV to check whether CR tank is charged / empty. If CR found empty, write down Empty CR on respective coach. With this, all the defects in the rake can be checked.

5. Again, connect BP & FP hose pipe of the rake & test rig & then charge BP to 5.0 kg/cm^2 & FP to 6.0 kg/cm^2. Connect BP & FP gauges with dummy on free end of other power car.

6. Check the BP & FP pressure gauges in front power car, BP pressure should show 5.0 kg/cm^2 & FP pressure should show 6.0 kg/cm^2. If there is any difference in any pressure, check by fitting master gauge if still the pressure is not showing 5.0 kg/cm^2 in BP & 6.0 kg/cm^2 in FP, check for leakage & attend.

7. Close the BP & FP angle cock of test rig for 03 minutes. Monitor the leakage in both BP & FP. The leakage should not be more than 0.6 kg/cm^2 in 03 minutes.

8. Attend the coaches in which AR empty & CR empty are found. Check the AR tank & pipe line from the back of the brake panel for leakage. Similarly, check CR tank & pipe line & dummy plug on the brake panel. If defect is still noticed after attending the leakage, than mark the coach sick for detailed investigation & single car testing in sick line.

9. Start the pressure & charge the BP to 5.0 kg/cm^2 & FP to 6.0 kg/cm^2. Drop the BP pressure by 1.6 kg/cm^2, brake should apply in all coaches. Start the leakage checking with the help of soap solution from one end. During soap solution testing, check all the BP & FP hose pipe, all hose pipe connectors, Main pressure pipe line, Angle cocks, Brake cylinder pipe line, CDTS pipe line. Similarly, check & attend leakage in components on Brake panel like DV, FP & BP filter, NRV, all isolating cock, brake indicator, brake accelerator & brake cylinder with soap solution.

10. Isolate the isolating cock on Brake panel & check all brake calipers & brake pad of all cylinders. In isolated condition, all brake pads should be released simultaneously. Similarly, on opening of isolating cock all Brake cylinder should operate & brakes should apply.

11. Check the brake indicator when brakes are applied, indicator should display red colour. However, when the brakes are released from isolating cock the brake indicator should display green colour. If on brake release condition, brake indicator is not showing green or on brake applied condition brake indicator is not showing red, then the brake indicator is defective. Repair / replace the brake indicator.

12. The BP & FP pressure gauges in the others end power car should show pressure 3.4 kg/cm^2 & 5.8 - 6.0 kg/cm^2 respectively. If any difference in above pressure is noticed that means there is any cross connection in BP & FP connection. Attend the same & ensure BP pressure 3.4 kg/cm^2 & FP pressure 5.8 - 6.0 kg/cm^2.

13. Charge the BP & FP pressure to 5.0 kg/cm^2 & 6.0 kg/cm^2 respectively. Check the brake indicator of complete rake, all coaches should be in released condition. If any coach is not released, it means that the CR of that particular coach may be overcharged & there is an internal defect in DV. Mark the coach sick for detailed investigation.

14. Check PEASD of at least 03 coaches. During PEASD checking, brakes should apply in all coaches & the brake accelerator should operate. Coach numbers should be noted in maintenance dairy.

15. Now closed the pressure supply from the test rig. Operate the emergency guard van valve of front power car guard van. BP pressure should become 0.0 kg/cm^2 in approx. 25 to 30 sec in front power car & approx. 40 to 50 sec in rear power car. Open the pressure supply & charge BP & FP to 5.0 kg/cm^2 & 6.0 kg/cm^2 respectively. Now again closed the pressure supply from the test rig. Operate the emergency guard van valve of rear power car guard van. BP pressure should become 0.0 kg/cm^2 in approx. 25 to 30 sec in rear power car & approx. 40 to 50 sec in front power car.

    Check for any significant difference in time for droppage of BP pressure to 0.0 kg/cm^2 between front & rear power cars. If any, there may be blockage in BP line of any coach. If found, attend the same. Continuity test of the rake is now completed.

16. In both the power cars, check the condition & mounting of hand brake cables fitted on both the brake cylinders. Rotate the hand wheel fitted in guard van clockwise to apply the brakes, after full rotation brake should apply in both the brake cylinders & hand brake indicator should show red. Rotate the hand wheel anti clockwise, now brakes of both the cylinders should get release & hand brake indicator should show green.

17. Charge the BP & FP to 5.0 kg/cm^2 & 6.0 kg/cm^2 respectively. Close the BP & FP angle cock of test rig for 03 minute. Monitor the leakage in both BP & FP. The leakage should not be more than 0.6 kg/cm^2 in 03 minutes.

18. Isolate the isolating cock of BP & FP of the test rig & angle cock of BP & FP of the cock. Uncouple both hose pipes & open both the angle cocks of coach. After draining of pressure from both the BP & FP hose, release the complete rake by pulling the manual release handle of the DV of each coach & ensure the brake indicator of all coaches should display

green colour. Ensure that all BP, FP & BC gauges fitted in power car are calibrated & showing correct reading.

WSP Testing

1. Initially with no pressure, the WSP processor in all the coaches should be OFF. If any processor is in ON condition, there is problem in any of pressure switch, wiring or K-05 relay. Attend the same.

2. Start the BP & FP pressure. The processor should automatically ON when BP pressure reaches 1.6 to 2.0 kg/cm^2 in M/s KNORR WSP system & when FP pressure reaches in M/s FTIL WSP system.

3. Check & attend for loose/proper fitment of WSP components like speed sensor, junction box, dump valve, dump valve connector & pressure switch.

4. Drop the BP pressure by 1.6 kg/cm^2, brake should apply in all the coaches. Now check the WSP processor for correct reading „99" on the electrical panel inside the coach. If the reading shows „99", it means that the WSP system is OK. Operate the test button on the processor to check the proper working of dump valves. The dump valve should operate in a sequence & pressure should be exhausted from brake cylinder. If the dump valve is not operated in proper sequence attend the same. Similarly, check & attend the WSP system of all the coach. All the WSP system should be in operating condition in the rake.

AIR BRAKE TESTING (Single Car) **ANNEXURE - B**

Coach no.		**Type**		**Date of Testing**	
POH Date		IOH		Return Date	
DV No.		DV Make		Bk. Equipment	
WSP make					

Pressure	BP	**Specified**	5 ± 0.1 kg/cm^2	**Actual**	
	FP		6 ± 0.1 kg/cm^2		

Pre-Inspection: Please ensure that all the pipe fittings, brake equipments are properly fitted and in place before starting of testing.

ITEM	TEST	SPECIFIED VALUE	ACTUAL VALUE	REMARKS
1.0	**Reservoir Charging**			
1.1	Charging time of AR (0 – 4.8 kg/cm^2)	175± 30 sec.(SAB) 60 to 120 sec.(KB)		
1.2	Charging time of CR (6.0 litre) (0 – 4.8 kg/cm^2)	165±20 sec.(SAB) 160 to 210 sec.(KB)		
1.3	BP Pressure	5.0±0.10 kg/cm^2		
1.4	CR Pressure	5.0±0.10 kg/cm^2		
1.5	FP Pressure	6.0±0.10 kg/cm^2		
2.0	**Sealing test** (Allow the system to settle for 2 min. after charging BP & FP. Observe the rate of leakage.			
2.1	BP (Less than 0.1 kg/cm^2 in 5 minutes)	BP<0.2 kg/cm^2/minute		
2.2	FP (Less than 0.1 kg/cm^2 in 5 minutes)	FP <0.2 kg/cm^2/minute		
3.0	**Full Brake Application**			
3.1	Reduce BP from 5.0 to 3.4 kg/cm^2	3 – 5 Sec.		
3.2	Brake Accelerator should not respond	Should not respond		
3.3	Maximum BC pressure	3.0 ±0.1 kg/cm^2		
3.4	Leakage in BC Pressure within 5	<0.1 kg/cm^2		
3.5	minutes	Applied		
3.6	All brake cylinder are applied Both side Brake indicators should show Red	Red		
4.0	**Release full Brake Application**			
4.1	Charge BP (up to 5.0 kg/cm^2)	5.0±0.1 kg/cm^2		
4.2	All brake cylinders are released	Released		
4.3	Both side Brake indicators should show Green	Green		
5.0	**Over Charge Protection** Check the overcharging of CR it should not be overcharged more than 0.1 kg/cm^2 in 10 second.	Less than 0.1 kg/cm^2 in 10 sec.		

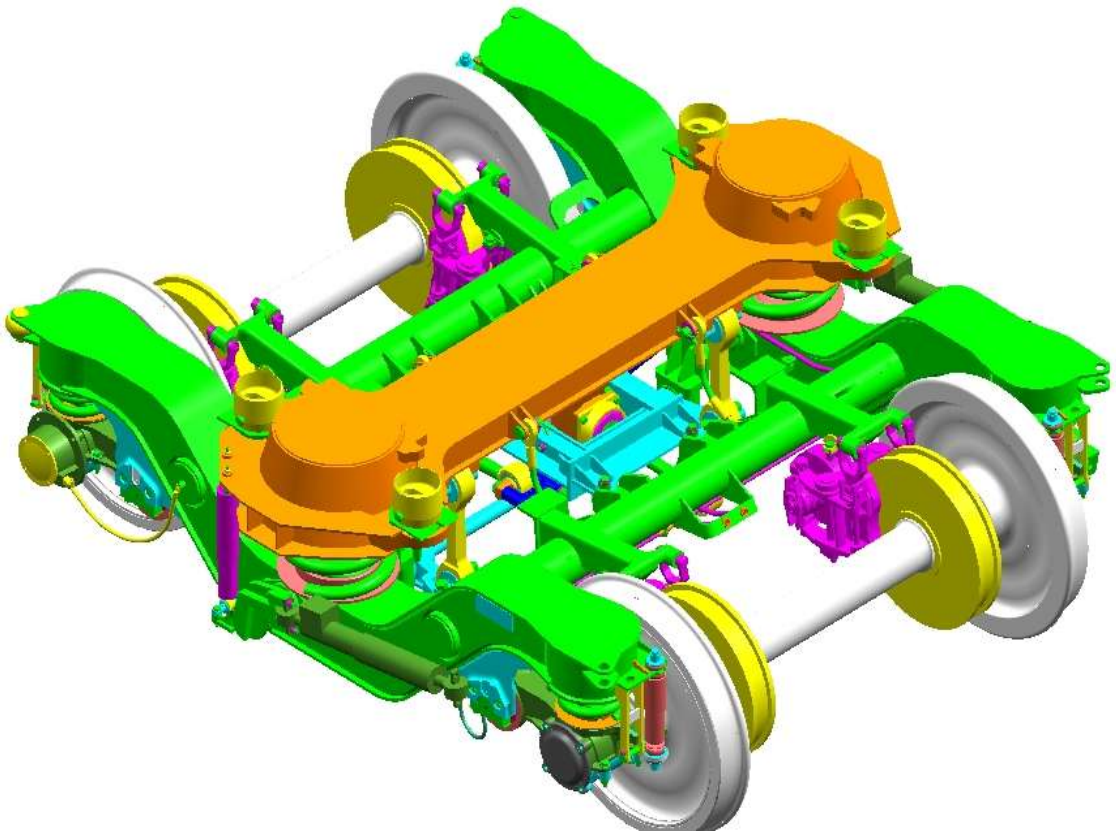
ITEM	TEST	SPECIFIED VALUE	ACTUAL VALUE	REMARKS
6.0	**Emergency Application**			
6.1	Reduce BP to 0 kg/cm^2	0 kg/cm^2		
6.2	Brake accelerator should respond	blast of air		
6.3	Charging time of brake cylinder (0 – 3.6 kg/cm^2)	3 – 5 Sec.		
6.4	Max. brake cylinder pressure	3.0 ± 0.1 kg/cm^2		
6.5	All Brake Cylinders applied	Applied		
6.6	Both side Brake indicator window should show red	Red		
7.0	**Release emergency Brake application**			
7.1	BC release time (Maximum to 0.4 kg/cm^2)	15 -20 Sec.		
7.2	All Brake Cylinder released	Released		
7.3	Both side Brake indicator window should show Green	Green		
8.0	**Graduated brake application and Release**			
	Graduated brake application and Release (Minimum 7 steps)	Brake should apply and release corresponding to decrease and increase of BP Pressure		
9.0	**Test for Pressure switch for Anti skid device**			
9.1	Charge the Feed pipe/Brake pipe*	Ok		
9.2	pressure	Ok		
9.3	Anti skid device get power supply at 1.8±0.2 kg/cm^2	Ok		
	Anti skid device get power supply off at 1.3±0.2 kg/cm^2			
	* For SAB - FP & For KB - BP.			
10.0	**Isolation Test**			
10.1	Close the isolating cocks for Bogie –1 & 2	Brake should not applied		
10.2	Reduce BP pressure to full brake application (Brake should not apply)	Green Brake apply		
10.3	Both side Brake indicators shows Green			
10.4	Open both isolating cock (Brake should apply corresponding to opening of isolating cock for bogies)	Red Brake will Release		
10.5	Both side Brake indicators shows Red	Green		
10.6	Again close the Isolating cock of bogie 1&2 one by one.			
10.7	Both side Brake indicators of bogie 1&2 shows Green one by one.			

ITEM	TEST	SPECIFIED VALUE	ACTUAL VALUE	REMARKS
11.0	**Sensitivity Test**			
11.1	Reduce the BP pressure at the rate of 0.6kg/cm2 in 6 second.	Brake should applied within 6 second		
12.0	**Insensitivity Test**	Brake should not applied		
12.1	Exhaust BP pressure at the rate of 0.3 kg/cm^2 Per minute			
13.0	**Passenger Emergency Pull Box testing**			
13.1	Pull the emergency pull box handle & check	BP pressure should remain 2.0±0.2 kg/cm^2		
13.2	Brake accelerator does respond.	should respond		
13.3	BP Pressure exhaust from emergency Brake valve	Yes		
13.4	Indicator Lamp on out side coach glowing	Yes		
13.5	Both side Brake indicators shows Red	Red		
13.6	After resetting, exhaust from emergency Brake valve is stopped	Should stop		
13.7	Both side Brake indicators shows Green	Green		
14.0	**Hand Brake test (Power car only)**			
14.1	Apply hand brake by means of wheel	OK		
14.2	Both side Hand Brake indicators shows Red	Red		
14.3	Brake Cylinders provided with hand brake lever are applied	Applied		
14.4	Movement of flex ball cable is proper	Yes		
14.5	Release hand brake by means of wheel	Ok		
14.6	Brake should release	Releases		
14.7	Both side Hand Brake indicators shows Green	Green		
15.0	**Emergency brake by guard van valve (Power car only)**			
15.1	Drop BP Pressure by means of guard valve (Brake Should apply)	Brake Apply		
15.2	Brake accelerator should respond	Blast of air		
15.3	Both side Brake indicators shows Red & Hand Brake indicators shows Green	OK		
15.4	Reset guard van valve (Brake should release)	Releases		
16.0	**Manual release test**			
	Apply full brake application and pull manual release wire of DV, it should be released in one brief pull of Manual release valve.	CR Drops to zero, Brake releases		

ITEM	TEST	SPECIFIED VALUE	ACTUAL VALUE	REMARKS
17.0	**WSP test**			
17.1	Check all Speed sensor air gap between sensor and Phonic wheel by means of filler gauge.	0.9 to 1.4 mm		
17.2	Charge the BP/FP Pressure at full specified value.	1.8±0.2 kg/cm^2		
17.3	Check the WSP Micro Processor activated	Activated		
17.4	Check the WSP Micro Processor showing code 99.	OK		
17.5	Check the Dump Valve venting by test mode	Venting one by one in proper sequence		
18.0	**Clearance between brake disc & brake pad**	1.5 mm		

NOTE

CHAPTER 4



BOGIE

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CHAPTER 4

BOGIE

4.1 INTRODUCTION

4.1.1 Technical Description

The FIAT Bogie is two-axle type, with a primary and a secondary suspension. The bogie assembly is shown in fig. 4-1. The Salient features of FIAT Bogie are:

- **Solid welded Bogie Frame** made up of two longitudinal components connected by two cross beams. The bogie frame rests on the primary suspension spring units and supports the vehicle body by means of Bolster beam. The Bolster beam is connected to the bogie frame by secondary suspension.

- **Primary suspension** consist of two steel coil springs (internal/external) laid out on the Control Arm upper part.

- **Secondary suspension** consists of two spring packs which sustain the bolster beam over the bogie frame. Each spring pack is made up by an internal and external spring. An Anti roll bar fitted on the bogie frame realizes a constant, reduced inclination coefficient during running. The bogie frame is linked to the bolster beam through two vertical dampers, a lateral damper, four safety cables and the traction rods. The bogie frame is linked to the coach body through two yaw dampers.

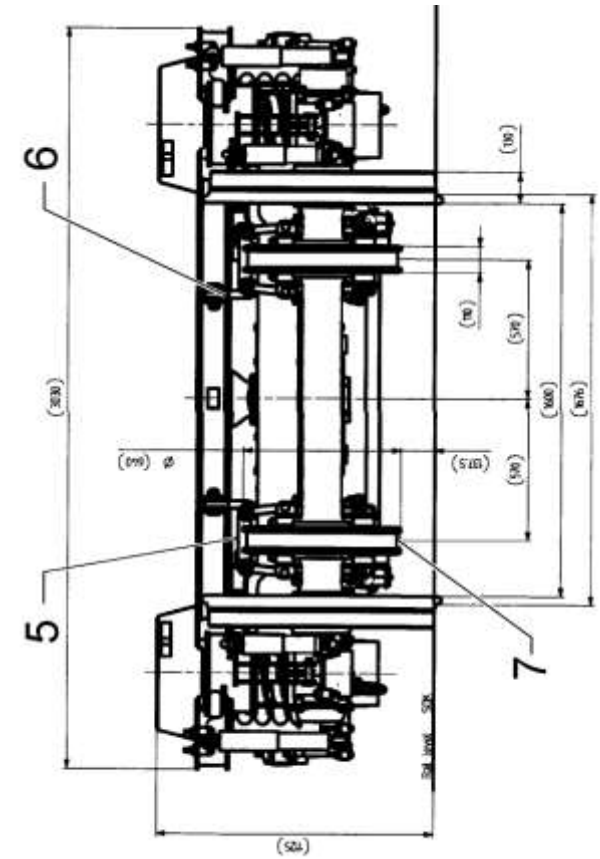
- **Traction Centre** - The traction Centre transmits traction and braking forces between bogie frame and body by a traction lever on the bolster beam pin and two rods.

- **Disk Brakes** – The FIAT bogie is fitted with pneumatic disk brakes. The pneumatically operated brake cylinders are fitted with automatic device for taking up the clearances.

- **Taper Roller Cartridge Bearing –** Fiat Bogie is fitted with 130 mm Cartridge type roller bearings.

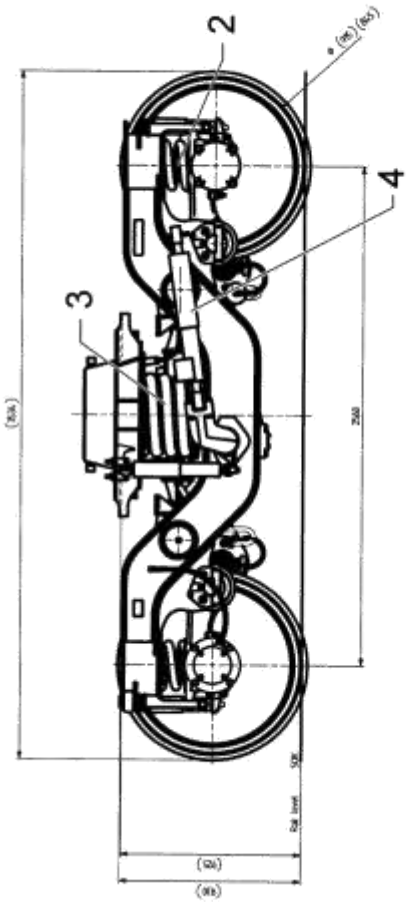
4.1.2 Main Technical Data

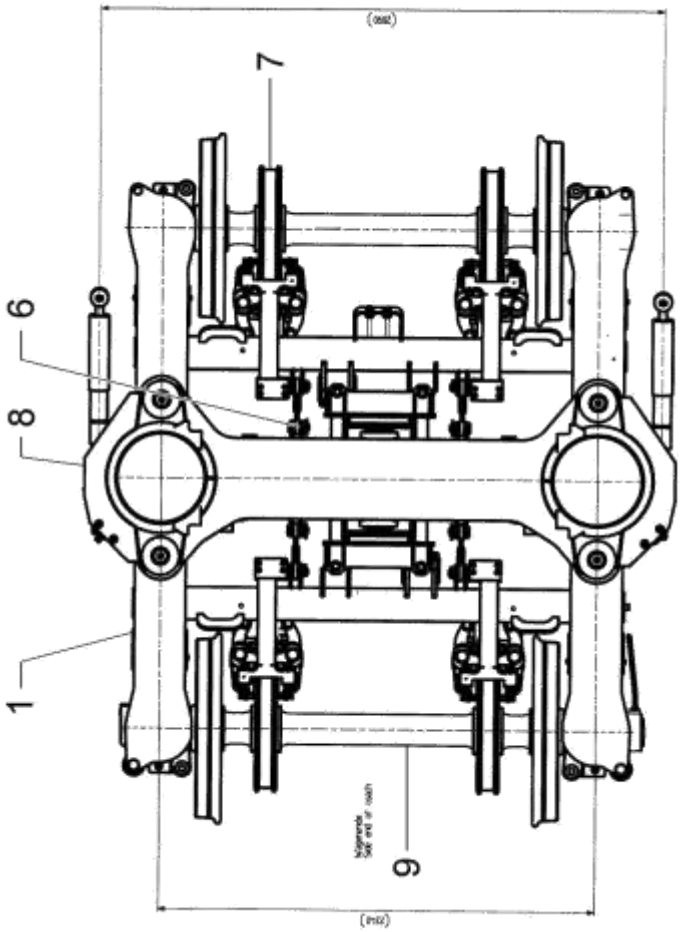
Axle distance	2560	mm
Diameter of new wheels	915	mm
Diameter of max. worn wheel	845	mm
Distance between the wheels	1600	mm
Brake disc diameter	640	mm
Bogie width	3030	mm
Bogie length	3534	mm
Bogie weight	6300	Kg



1. Bogie frame
2. Primary suspension
3. Secondary suspension
4. Yaw damper
5. Lateral damper
6. Safety cables
7. Brake disc
8. Bolster beam
9. Axle

FIG. 4-1 Bogie Assembly





There are four variants of the bogie: 1267400, 1267334, 1267700 and LW08001 . The main differences in these variants are shown in Table 4.1.

Table 4.1 BOGIE DIFFERENCES
DRAWING NUMBERS AND CHARACTERISTICS FOR DIFFERENT ITEMS

Component / Item	**AC- Chair Car (I^{st} & 2^{nd}), Hot buffet, AC-2T/EOG, FAC/EOG Side 1+2 (each)**	**Gen-Van Side 1**	**Gen-Van Side 2 (luggage compartment)**	**AC-3T EOG**
Bogie main assembly	1 267 400	1 267 334	1 267 700	LW 00001
Primary suspension assembly	1 268 732	1 272 174	1 272 174	LW01001
Spring (outer)	1 267 411	1 277 142	1 277 142	1267411
Spring (inner)	1 267 412	1 277 143	1 277 143	1277143
Secondary suspension assembly	1 268 801	1 268 838	1 277 151	LW05001
Spring (outer)	1 269 514	1 277 146	1 268 836	1268836
Spring (inner)	1 269 513	1 277 145	1 268 837	1269513
Frame assembly	LW 03007	LW 03008	LW 03007	LW03007
Handbrake support	No	Yes - 1 267 798	No	No
Brake assembly	1 268 820	1 272 116	1 272 112	1268820
Ratio of brake-caliper	1 : 2.17	1 : 2.48	1 : 2.48	1:2.17
Handbrake/Flexball	No	Yes 1272184201/02 67060000 1272185201/02 67050000	No	No.

4.1.3 Bogie Frame

The bogie frame is a solid welded frame made by steel sheets and forged or cast parts.
The frame is made up of two longitudinal components (1) connected by two cross-beams (2) which also support the brake units. The various supports which connect the different bogie components are welded to the frame. The bogie frame rests on the primary suspension spring units and supports the vehicle body by means of a bolster beam. The bolster beam is connected to the bogie frame by the secondary suspension.

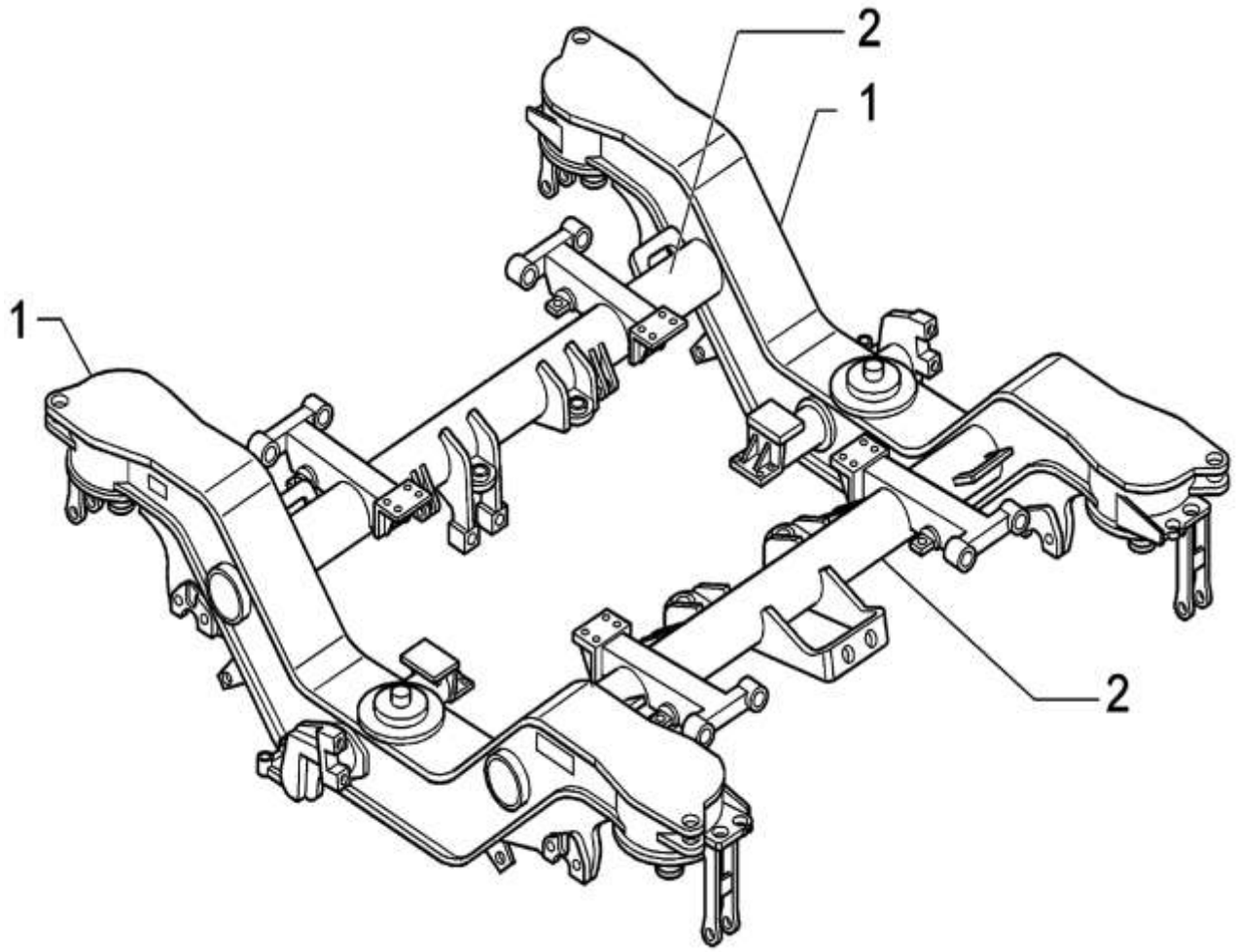


FIG. 4-2 Bogie Frame

1. Bogie frame longitudinal component
2. Cross-beam

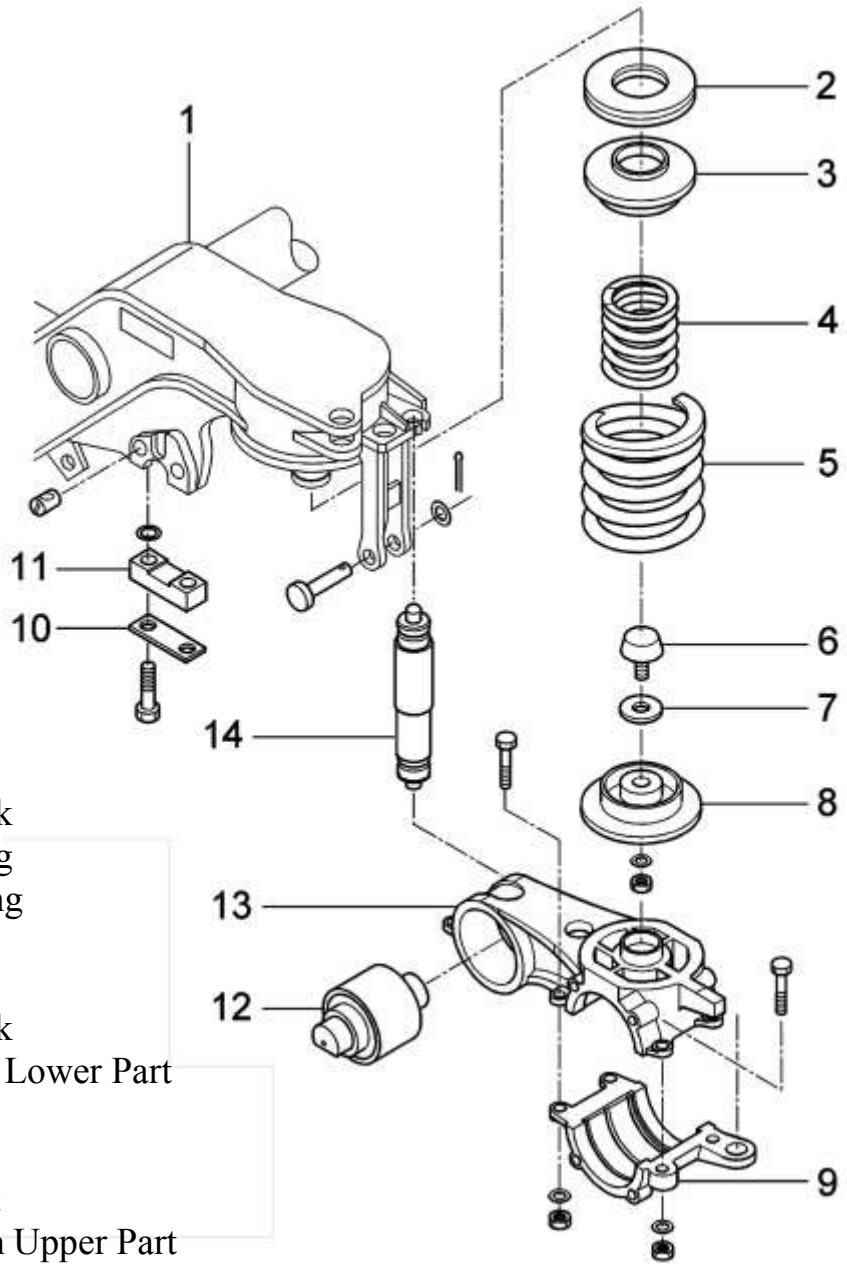
4.1.4 Primary Suspension

Primary suspension is implemented by two units (see FIG. 4-3) of two steel coil springs (internal (4) and external (5)) laid out on the control arm upper part (13) by a centering disk (8) and adjustment shims (if required).

The suspension is also completed by the following components:

- A control arm (13), fitted with twin-layer elastic joints (12), connecting the axle bearing to the bogie frame and transmitting, not stiffly, lateral, longitudinal and part of the vertical forces;
- A vertical damper (14).

Rubber elements (2) separate the primary suspension from the bogie to realize noise reduction.



1. Bogie frame
2. Rubber disks
3. Centering disk
4. Internal spring
5. External spring
6. Bump stop
7. Shim
8. Centering disk
9. Control Arm Lower Part
10. Plate
11. Block
12. Rubber joint
13. Control Arm Upper Part
14. Damper

FIG. 4-3 Primary Suspension

4.1.5 Secondary Suspension

4.1.5.1 Steel Coil spring in secondary suspension stage

The secondary suspension enables lateral and vertical displacements and bogie rotation with respect to body when running through curves.

It is implemented by two spring packs (FIG. 4-4) which sustain the bolster beam (1) over the bogie frame (6). Each spring pack is made up by an internal (3) and an external spring (4), mounted and positioned through the centering discs (5).

An anti-roll bar (2), fitted on the bogie frame (6), realizes a constant, reduced inclination coefficient during running.

The bogie frame is linked to the bolster beam through two vertical dampers (7), a lateral damper (8), four safety cables (9) and the traction rods (10).

The bogie frame is also linked to the coach body through two yaw dampers (11).

4.1.5.2 Air spring (Pneumatic suspension) in secondary suspension stage

4.1.5.2.1 Introduction

Air suspension is a suspension where properties of air are used for cushioning effect (springiness). Enclosed pressurised air in a pre-defined chamber called air spring, made up of rubber bellow & emergency rubber spring, provides various suspension characteristics including damping. Air springs are height-controlled load levelling suspension devices. With changing loads, air spring reacts initially by changing the distance between air spring support and vehicle body. The height monitoring valve (called levelling valve) is in turn actuated, either taking the compressed air pressure to the air spring or releasing air pressure from it to the atmosphere. This process continues until the original height is restored. This mechanism ensures a constant floor height on coaches provided with air springs, irrespective of the load. This greatly reduces problems associated with low buffer / coupler heights.

4.1.5.2.2 Construction details:

Construction details of air spring are shown in Fig.4-3 (air spring with internal emergency spring), & Fig.4-4 (air spring with external emergency spring).

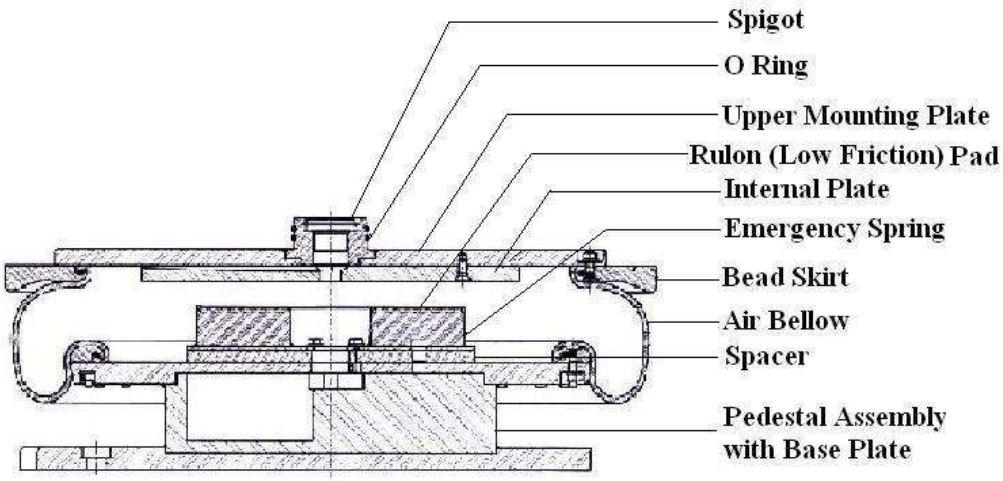


FIG. 4-3 Air Spring Assembly With Internal Emergency Spring

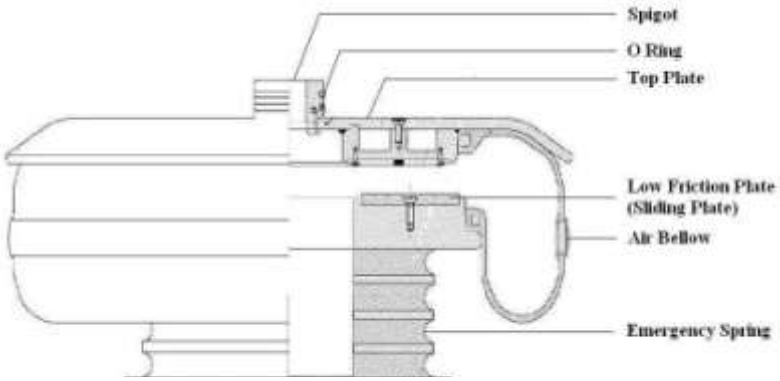


FIG. 4-4 Air Spring Assembly With External Emergency Spring

4.1.5.2.3 Schematic layout of pneumatic suspension control equipments:

A schematic layout of pneumatic suspension control equipments has been provided in Fig.4-5.

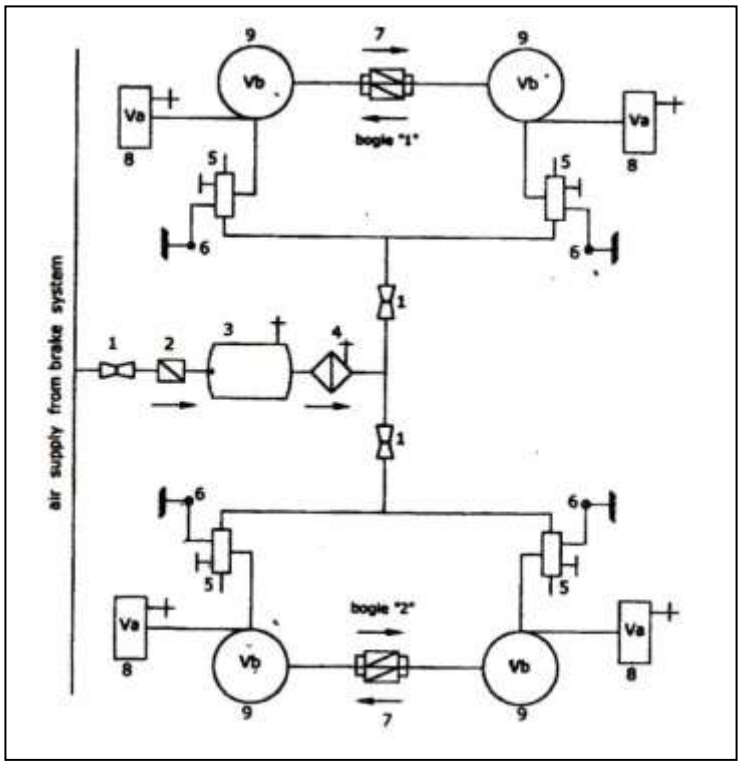


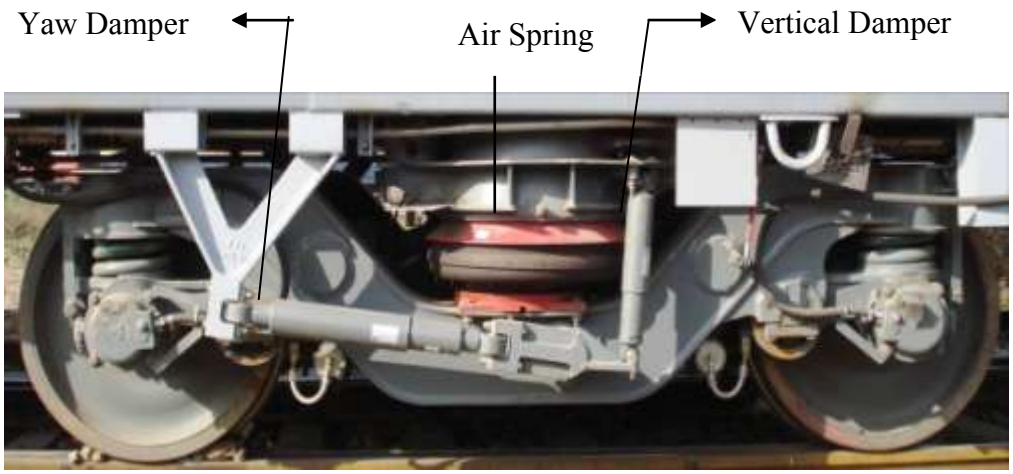
FIG. 4-5 SCHEMATIC LAYOUT OF PNEUMATIC SUSPENSION CONTROL EQUIPMENTS

S. N.	Description	Quantity/Coach
1	Isolating cock	3
2	Dirt Collector	1
3	150 Lit. Reservoir with drain cock (Main Reservoir)	1
4	Check Valve	1
5	Levelling Valve	4
6	Installation lever	4
7	Duplex check valve	2
8	Auxiliary Reservoir (inbuilt in Bolster beam having 60 lit. capacity)	-----
9	Air spring assembly	4

4.1.5.2.4 Modification for fitment of air spring if required:

Bogie Frame & Suspension:

- Air spring has been installed at secondary stage replacing steel coil springs.
- A square platform (base) to accommodate the air spring has been provided on Y-frame of bogie.
- A lateral hydraulic damper and lateral bump stop have been provided at secondary stage.
- Primary springs have been retained as steel spring.
- Details are shown in picture below.
- Leveling valve provided between bogie frame and bogie bolster.



Bogie bolster:

- Provision is made for air inlet to air spring.
- Dome of Bolster beam has been used as an additional reservoir of 60 lit. for each air spring.
- Duplex check valve is provided.

Under frame:

- A pipeline is drawn from M.R pipe (feed pipe) for pneumatic suspension.
- One isolating cock, one non return valve, one 150 lit air reservoir (auxiliary reservoir) one air filter and two separate isolating cocks to isolate each bogie have been provided.

Base plate:

- Base plate shall be as per drawing No. RDSO CG- K5057 alt „b".

4.1.5.2.5 Inspection & maintenance of air spring:

- Inspect for any water collection in rubber bellow of air spring
- Inspect the air spring for any damage or leakage.
- Inspect air spring seat and top plates for corrosion, if corrosion noticed is paint with primer & black paint.

4.1.5.2.6 Inspection & maintenance of rectangular platform provided on y- frame:

- Inspect air spring fixing holes of square platform provided on y- frame of bogie for elongation, if elongated build them to dia.24 mm or dia. 44 mm.
- Inspect the corrosion on top surface of square platform provided on y- frame of bogie, Remove the corrosion paint with primer and black paint.

4.1.5.2.7 Inspection of pipe line:

- The air spring piping may be checked for any leakage/damage by soap test and repair if required.

4.1.5.2.8 Leakage test of air spring:

- Connect the hosepipes on the under frame piping with the levelling valves of the bogies.
- Connect pressure gauges to the drain plug locations of 150-litre reservoir.
- Provide packing in the gap between bolster & bogie frame.
- Connect the 150-litre reservoir on the under frame to the compressed air source of pressure 6.0 kgf/cm^2.
- Allow air into the air springs to a value of 6.0 kgf/cm^2 in the pressure gauge by adjusting the horizontal lever of the levelling valve and keep it in the same position.
- Close the isolating cock connecting MR pipe with 150-litre reservoir.
- Test all pipe joints for leakages.
- Check the pressure gauge readings after 15 min. The pressure drop should be within 1% of the test pressure 6.0 kgf/cm^2.
- Release the air completely by dropping the horizontal lever.
- Remove the packing.

4.1.5.2.9 Procedure for checking bogie clearances on ac and non ac coaches provided with air springs :

- Firstly find out the type of bogie as AC 2T EOG Hot Buffet Car, Generator Car and Double Decker AC Chair Car coaches. List of relevant drawings are as under:

TYPE OF COACH	RCF DRAWING No.
AC 2T EOG	LW90033
Hot Buffet Car	
Generator Car	
Double Decker AC Chair Car	

- Then the coach shall be placed at leveled track.
- The primary springs shall be grouped as per Annexure – 1 in which the different type of primary springs is grouped for air spring bogie.
- The primary springs are used for the air spring bogies as follows:

TYPE OF SPRING	RCF DRAWING No.	TYPE OF COACH
Primary Inner	1277143 Version 01	AC 2T EOG, Generator Car, Double Decker AC Chair Car
	1267412 Version 05	Hot Buffet Car
Primary Outer	1267411 Version 04	AC 2T EOG, Hot Buffet Car
	1277142 Version 01	Generator Car, Double Decker AC Chair Car

- Secondary suspension arrangement drawing is given as under:

TYPE OF COACH	RCF DRAWING No.
AC 2T EOG	LW05004
Hot Buffet Car	
Generator Car	
Double Decker AC Chair Car	

- Primary suspension arrangement drawing is given as under:

TYPE OF COACH	RCF DRAWING No.
AC 2T EOG	LW01001
Hot Buffet Car	1268732
Generator Car	1272174
Double Decker AC Chair Car	

- Then maintain the bogie corner heights as per following Bogie General Arrangement drawing.

TYPE OF COACH	RCF DRAWING No.
AC 2T EOG	LW00007
Hot Buffet Car	LW00009
Generator Car	LW00010 (for side 1) and LW00011 (for side 2)
Double Decker AC Chair Car	LW00011

- After the bogie corner height is maintained, adjust the air spring height as per relevant suspension diagram with the help of installation lever.

4.1.5.2.10 Procedure for adjustment of Installation Lever.

- Keep the coach on a level track.
- Connect the pressure gauges to the drain plug locations of all 60 lit. reservoirs in a bogie.
- Adjust the length of all installation levers as per requirement to connect them to lever of levelling valve.
- Supply compressed air to the bogie.
- Adjust the design height of air spring to 292^{+0}_{-5} mm by gradually increase or decrease the length of installation lever.
- Repeat the same procedure for the other side of air springs of same bogie.
- Recheck the design height of all air springs of same bogie and make minor adjustment if required to maintain the design height of all four air springs in same bogie between 292 to 287 mm.

CAUTION:

If the difference in pressure of the air in the air springs of the same bogie is more than setting pressure of the duplex check valve i.e. 1.5 bar, then the air will continuously escape from one air spring to the other through the duplex check valve and then to atmosphere.

- Tightened the installation lever lock nuts with the horizontal lever of leveling valve, so that the setting will not be disturbed.
- Repeat the above procedure for the second bogie.
- Disconnect the pressure gauges and replace the drain plug.

4.1.5.2.11 Checks for proper fitment of air spring assembly

- Check air spring vertical symmetry

- No pre twist in air spring top plate during fitment
- No push fittings in air spring holdings
- Leveled top and base plate of air spring

4.1.5.2.12 Problem and their reasons

S.No	Nature of problem	Reasons
1	Inadequate bogie clearances	• Improper initial settings of leveling valve • Improper functioning of leveling valve • Non uniform wear in bogie parts
2	Failure of lateral damper	• Damper fitting misalignment • Inadequate damper stroke • Pre angular twist in end fasteners due to level difference
3	Non lifting of air spring	• Low air pressure • Heavy air leak in pipe connections • Fully choked leveling valve inlet port
4	Delayed lifting of air spring	• Perished rubber seat of lower diaphragm in leveling valve • Partly choked wire mesh in leveling valve inlet port • Back lash error in leveling valve rotation

4.1.5.2.13 Dismantling of air spring from rectangular platform provided on Y- frame of bogie and bogie bolster:

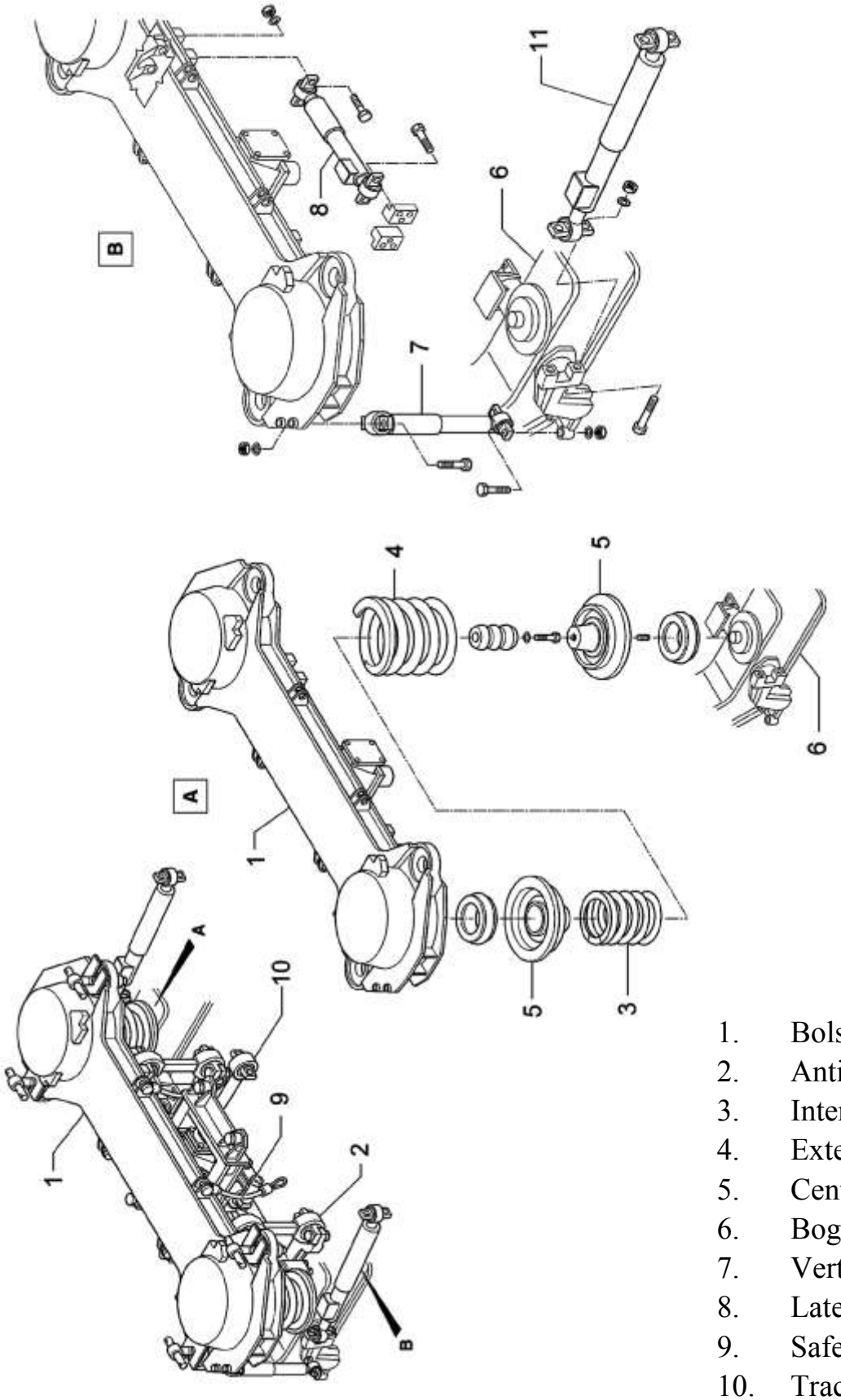
- Remove All Body, Bogie connections
- Remove duplex check valve from bolster
- Remove lateral & vertical shock absorber
- Remove connection between arm of levelling valve & installation lever.
- Remove all 4 Nos. Bolts and nut with the help of suitable Allen key and suitable spanner from bottom plate of air spring & square platform provided on y- frame of bogie.
- Lift bolster up to bogie frame to clear the spigot of air spring.
- Slide air spring from square platform provided on y- frame of bogie.

Note: Upto five years of fitment of air spring attention should be given during dismantling of bolster beam that air spring should not be opened.

4.1.5.2.14 Mounting air spring on rectangular platform provided on Y- frame of bogie and bolster:

- "O" rings provided on air spring spigot must be changed.

- Mount air spring on square platform provided on y- frame of bogie and match the holes of bottom plate of air spring and holes of square platform provided on y-frame of bogie.
- Tight all 4 nut-bolts with the help of suitable allen key and suitable spanner.
- Place the bolster beam on air spring ensuring no damage to spigot of air spring.
- Connect levelling valve arm with installation lever.
- Mount vertical and lateral shock absorber.
- Connect all flexible/fixed pipe connections of bogie
- All the threaded joints of air spring be sealed with thread sealing tape to avoid air leakage.
- The filter of levelling valve must be cleaned.



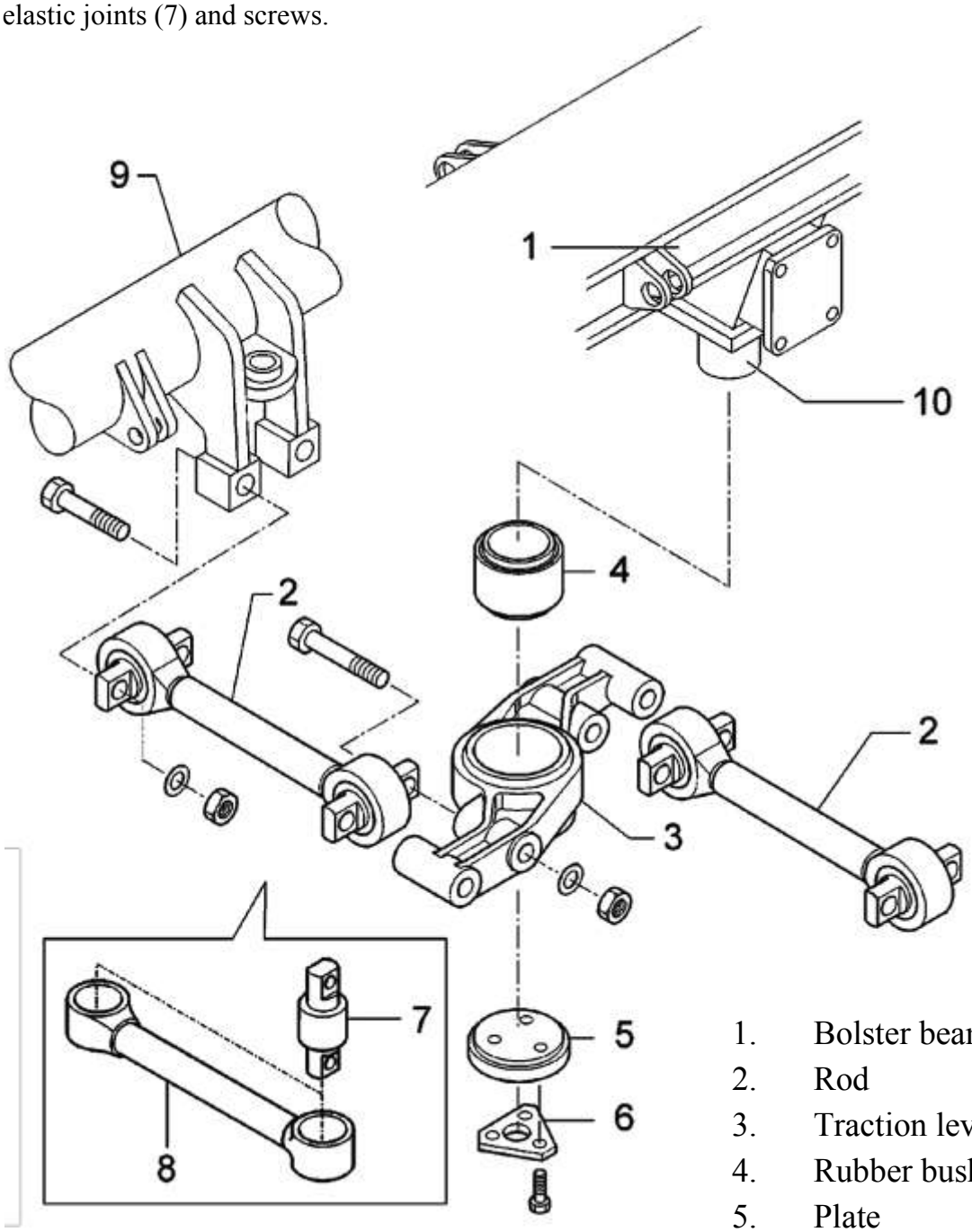
1. Bolster beam
2. Anti- roll bar
3. Internal spring
4. External spring
5. Centring disk
6. Bogie frame
7. Vertical damper
8. Lateral damper
9. Safety cables
10. Traction rod
11. Yaw damper

FIG. 4- 4 Secondary Suspension Unit

4.1.6 Traction Centre

The traction centre (see FIG. 4-5) transmits traction and braking forces between bogie frame and body by a traction lever (3), on the bolster beam pin (10), and two rods (2).

The traction lever is connected to the bolster beam by means of a rubber bush (4), two plates (5, 6) and screws, while rods are connected to the bogie frame and to the traction lever by elastic joints (7) and screws.

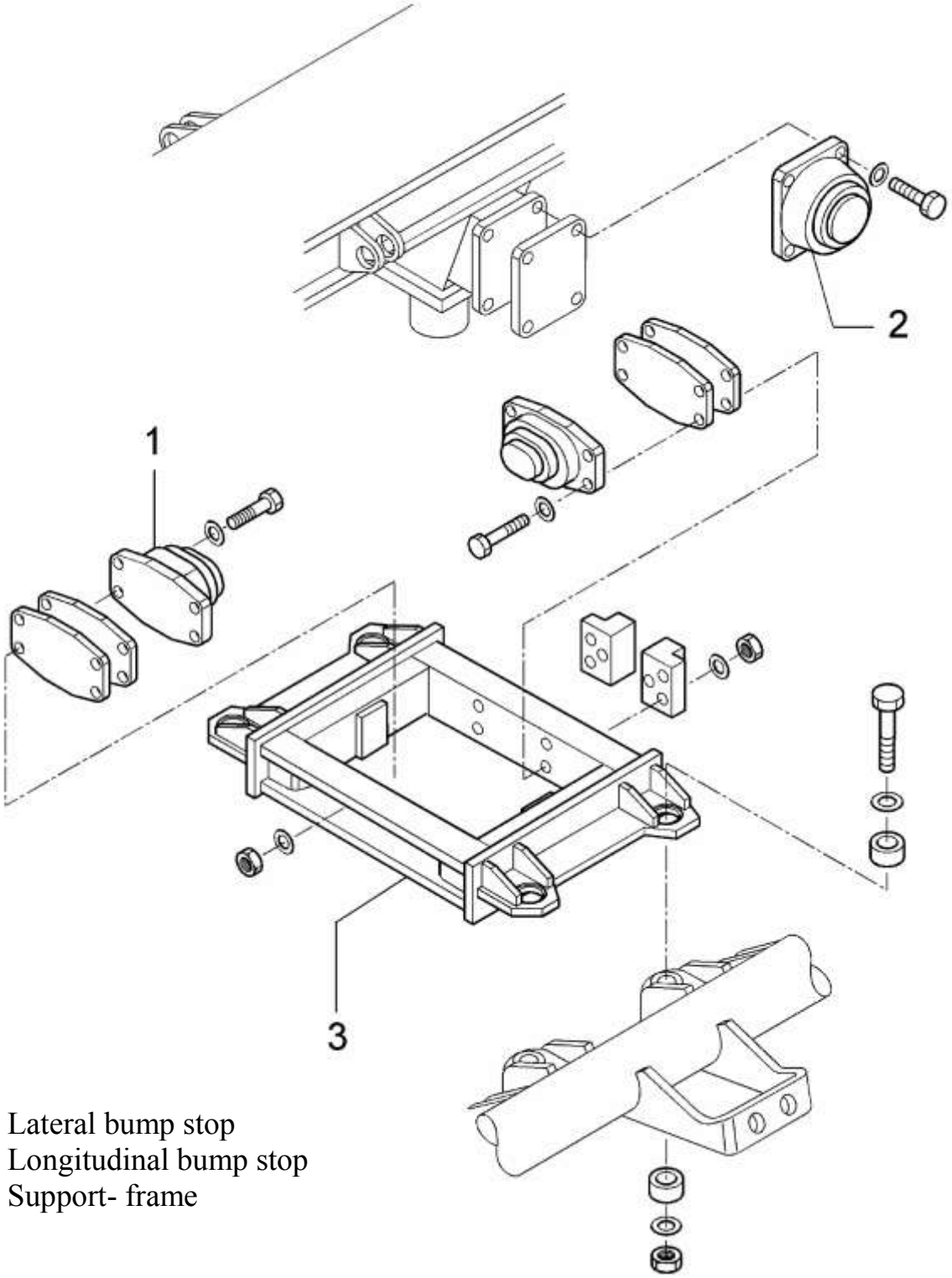


1. Bolster beam
2. Rod
3. Traction lever
4. Rubber bush
5. Plate
6. Plate
7. Elastic joint
8. Rod
9. Bogie frame
10. Pin

FIG. 4- 5 Traction Centre

4.1.7 Auxiliary Components

The bogie is completed by a device for limiting the longitudinal and lateral displacements of the bolster beam, made by four bump stops (FIG. 4-6), two longitudinal (2) and two laterals (1).

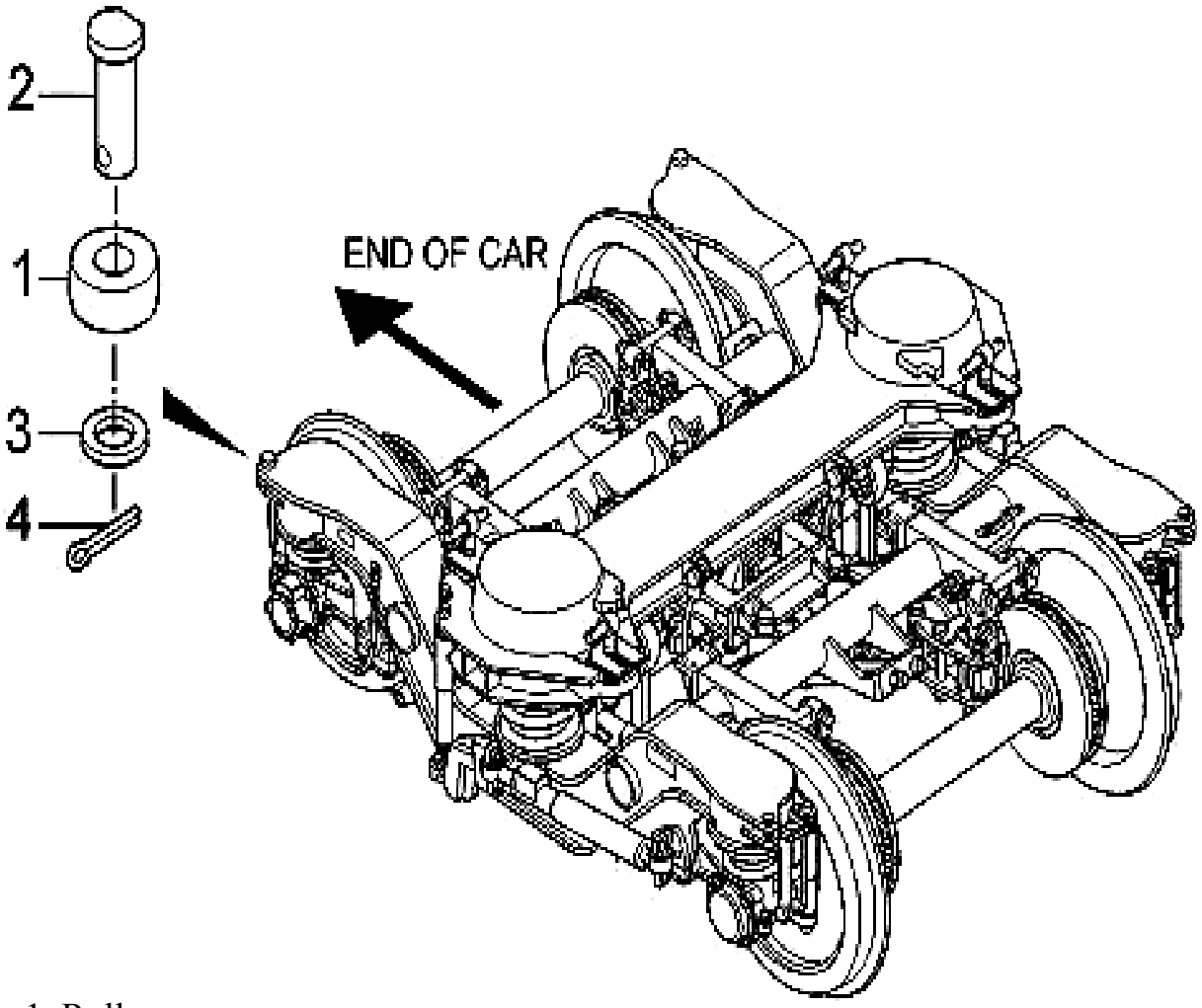


1. Lateral bump stop
2. Longitudinal bump stop
3. Support- frame

The four of them are supported by a small frame (3) screwed to the bogie frame.

FIG. 4- 6 Longitudinal And Lateral Bump Stops

At the two outer corners of the frame it is also mounted a roll (1-FIG. 4-7) which prevents excessive rotation of the bogie when under the car body. The roll (1) is fixed by a pin (2), a washer (3) and a safety split pin (4).



1. Roll
2. Pin
3. Washer
4. Split pin

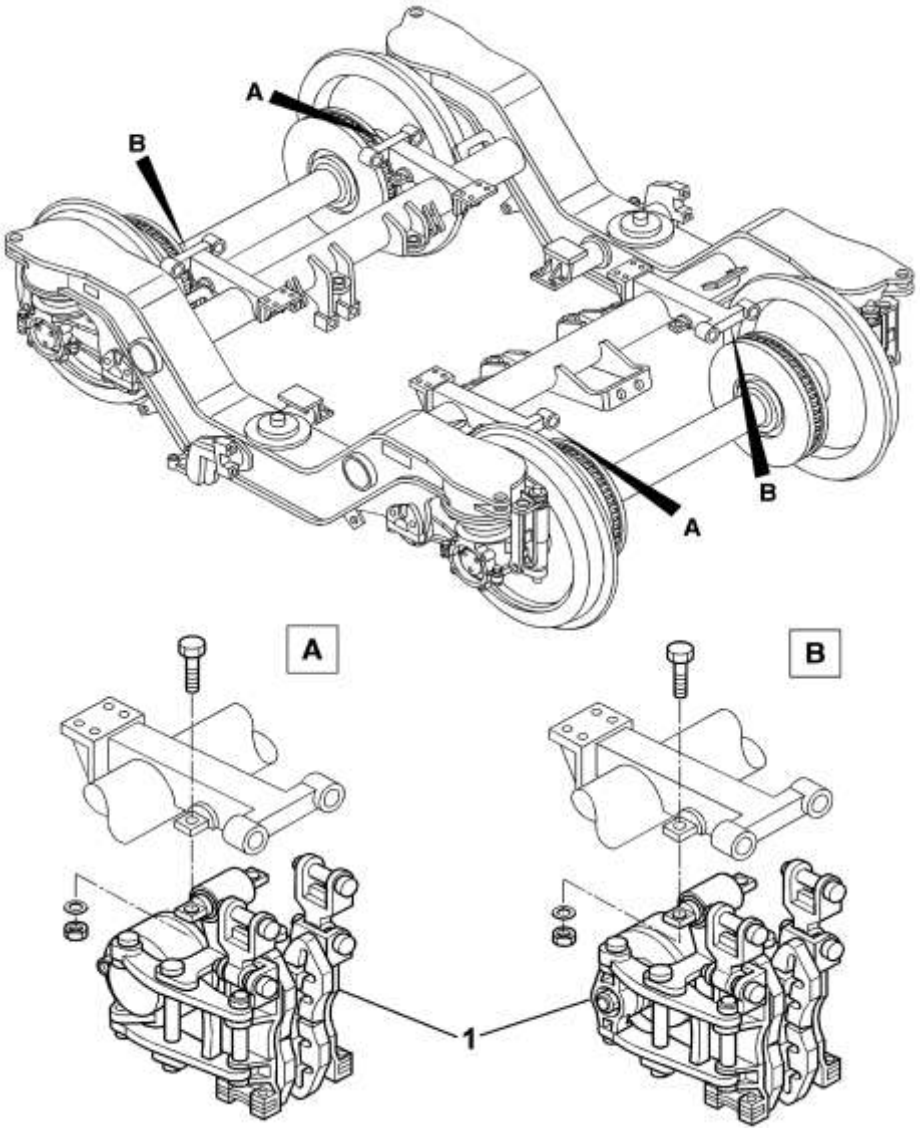
FIG. 4- 7 Corner Rolls

4.1.8 Installed Braking Systems

The pneumatic braking systems acting on the bogie are as follows:

- Pneumatic disk braking only (see FIG. 4-8), covering the whole speed range and acting on both axles for bogies 1267400 and 1267700.
- Pneumatic disk braking and hand-operated brakes acting on both axles for bogie 1267334.

Pneumatic braking is implemented by pneumatically operated brake cylinders fitted with an automatic device for taking up clearances. Air to spring brake cylinders is supplied through two compressed air pipes, one for the brakes of the first axle, and the other for the second axle. Brake cylinder action is transmitted, through two levers and a balancing arm, to a pair of pad holders, which perform braking on relevant disk.



1. Brake unit

FIG. 4- 8 Braking System For Bogies 1267400 And 1267700

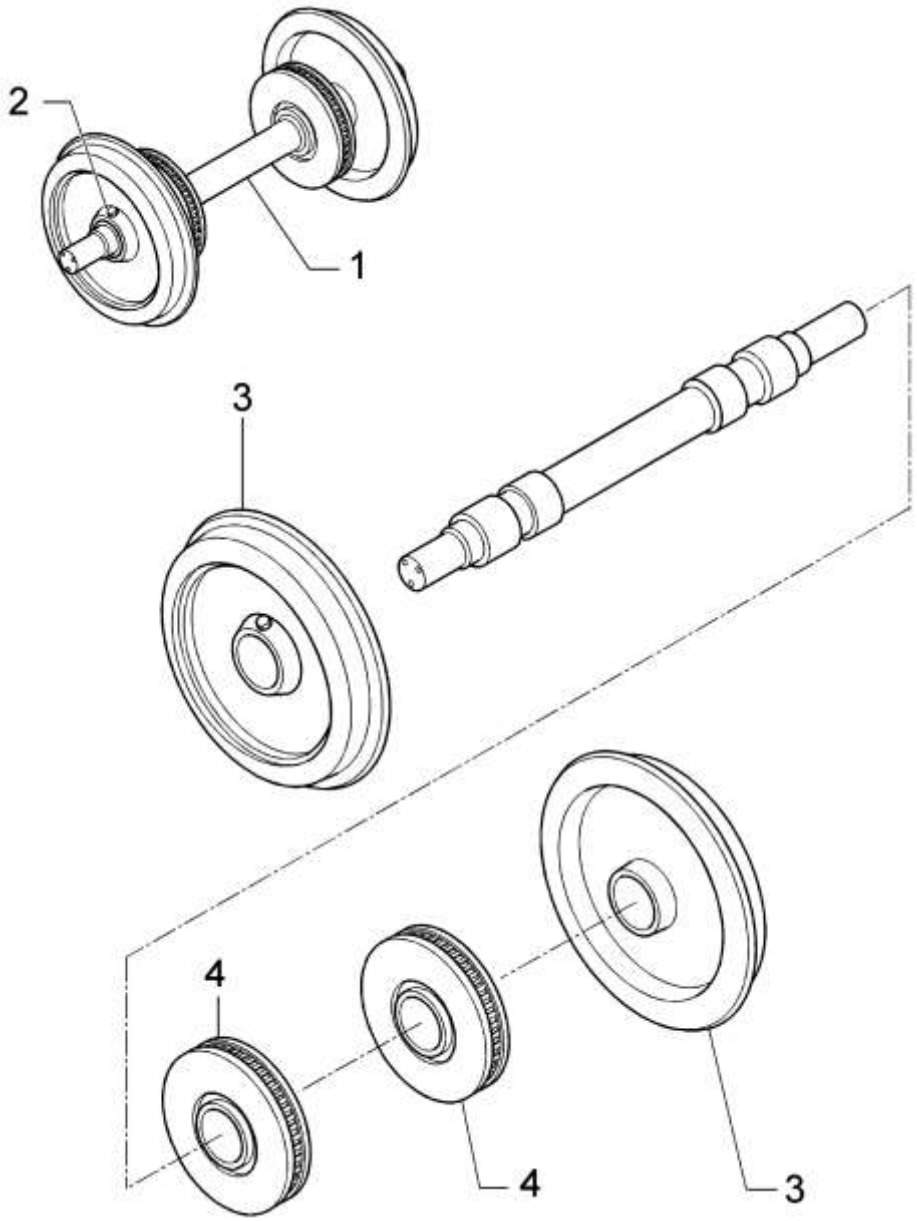
4.1.9 Brake Discs

On the bogie each axle (1) is fitted with two brake disks (4), diameter 640 mm and width 110 mm. Disks belong to the type with a low ventilation; friction lining in organic material operate on each disk, by means of proper links, by the relevant brake cylinder fitted with an automatic device for taking up clearances.

Note: Please refer to chapter on Air Brake system for more details.

4.1.10 Wheels

At axle ends are fitted wheels (3). Wheels are fitted with a side pipe, sealed by a plug, for letting in high pressure oil during wheel removal.



1. Axle
2. Plug
3. Wheel
4. Brake disk

FIG 4- 9 Bogie Axles

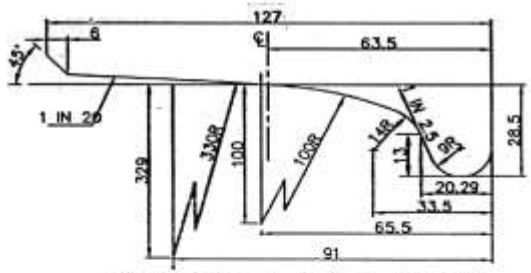


FIG.1: 20mm THICK FLANGE

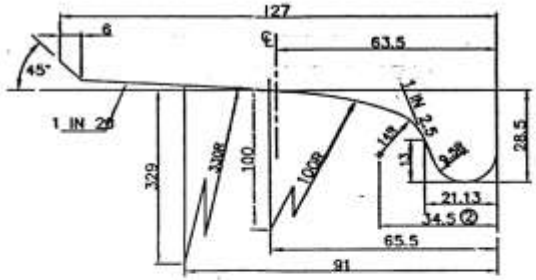


FIG.2: 21mm THICK FLANGE

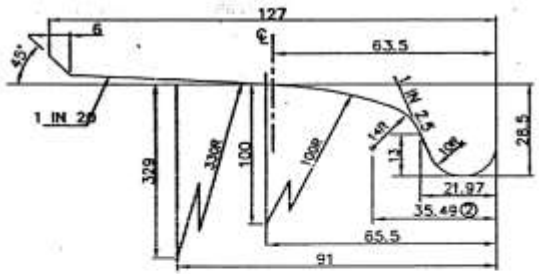


FIG.3: 22mm THICK FLANGE

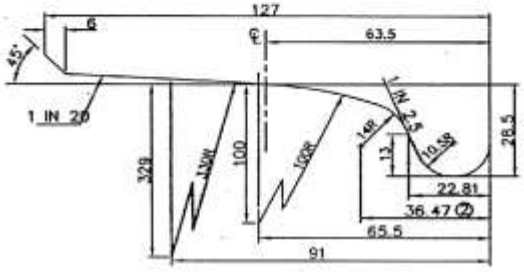


FIG.4: 23mm THICK FLANGE

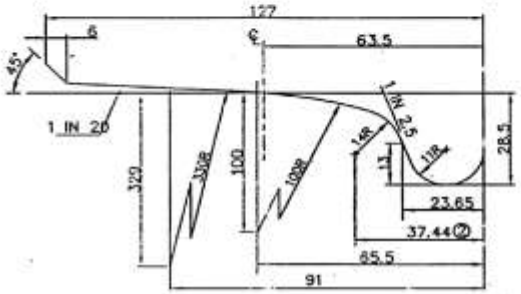


FIG.5: 24mm THICK FLANGE

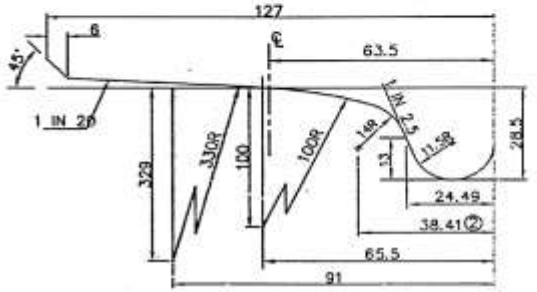


FIG.6: 25mm THICK FLANGE

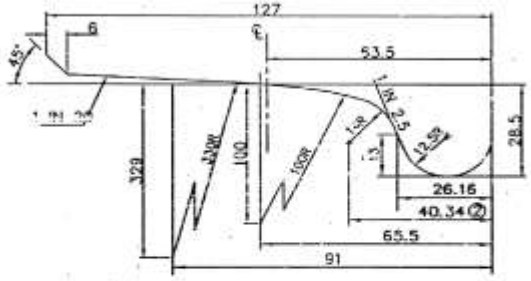


FIG.7: 26mm THICK FLANGE

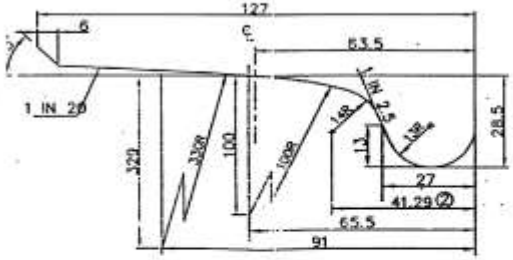


FIG.8: 27mm THICK FLANGE

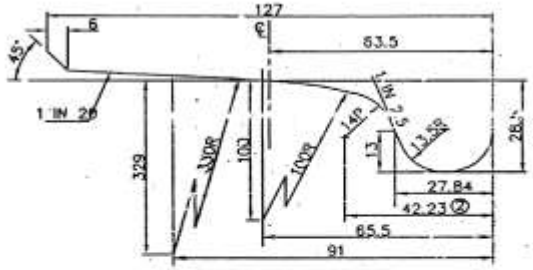


FIG.9: 28mm THICK FLANGE

NOTE:-

1. INTERMEDIATE WORN WHEEL PROFILES OF 25mm TO 28mm THICK FLANGE (FIG.6 TO 9) SHOULD ONLY BE USED FOR THE COACHES TO RUN AT MAXIMUM PERMISSIBLE SPEEDS OF 110 kmph AND ABOVE.
2. ALL THE 9 INTERMEDIATE WORN WHEEL PROFILES (FIG.1 TO 9) CAN BE USED FOR WHEELS FOR OTHER TYPE OF COACHES.

ALT.	ITEM	AUTHY.	DESCRIPTION	DATE
②	–	SS/01/12	DIMENSION 34 (FIG.2), 36.5 (FIG.3), 36.34 (FIG.4), 37.32 (FIG.5), 38.3 (FIG.6), 40.21 (FIG.7), 41.17 (FIG.8) AND 42.11 (FIG.9) CORRECTED AS 34.5, 35.49, 36.47, 37.44, 38.41, 40.34, 41.29 AND 42.23 mm RESPECTIVELY.	01/12
①	–	SS/03/10	INTERMEDIATE WORN WHEEL PROFILES OF 21,23,24, 26,27 AND 28mm THICK FLANGE ADDED AND EXISTING PROFILES OF 20,22 & 25mm THICK FLANGE MODIFIED. NOMENCLATURE OF FIG.1 TO 2, FIG.3 DELETED AND FIG.1 TO FIG.9 ADDED FOR ALL 9 PROFILES. NOTE 1 AND 2 MODIFIED.	03/10

	SUPERSEDED BY
ASSY. DRGS	SUPERSEDES
REFERENCE	SCALE 1: 1
FLOPPY No.	B.G.

P C D T J.S.

R.D.S.O. [C]

INTERMEDIATE WORN WHEEL PROFILE FOR COACHING STOCK

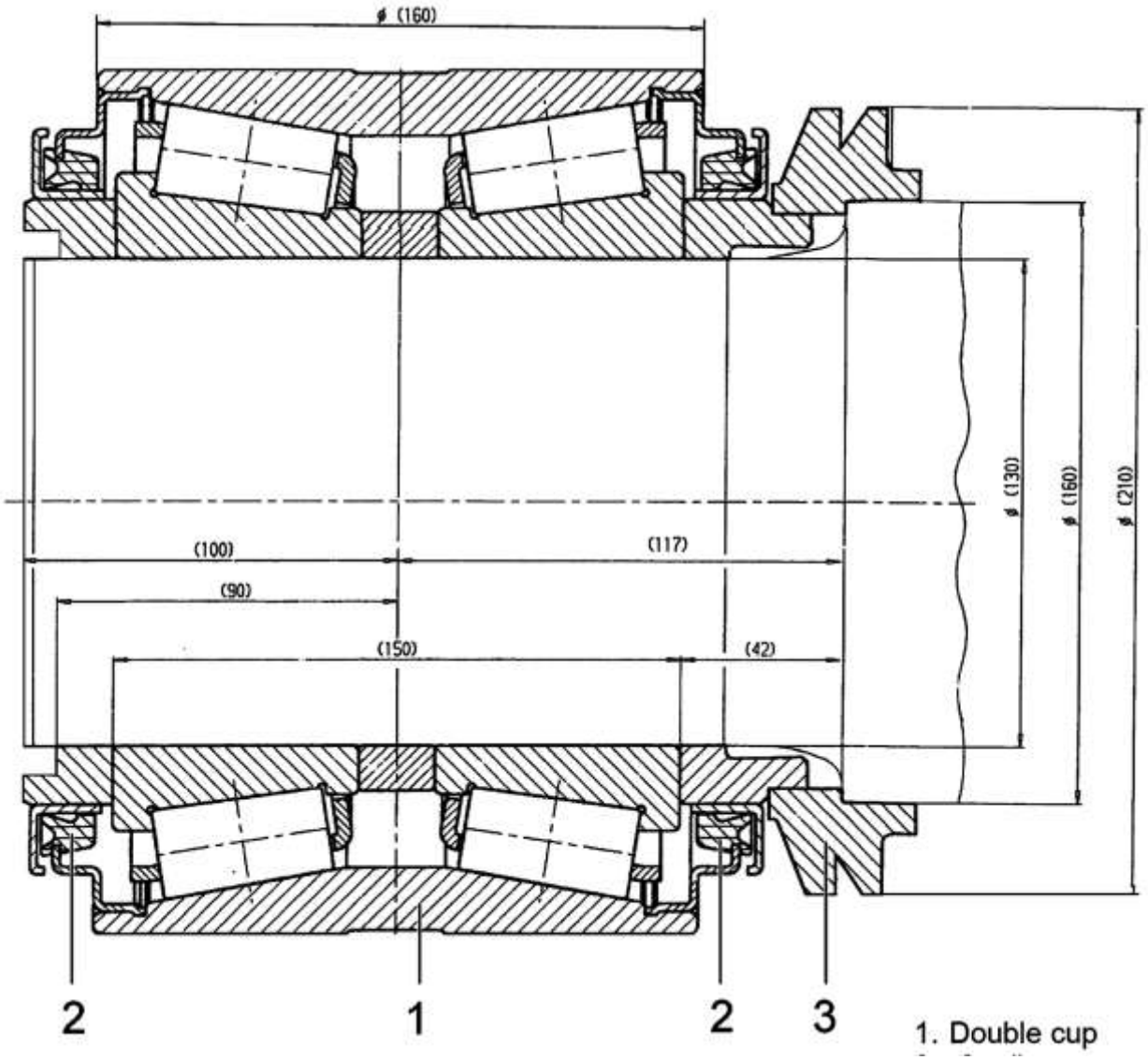
GROUP (XII)2

SKETCH-92082

4.1.11 Axle Bearings

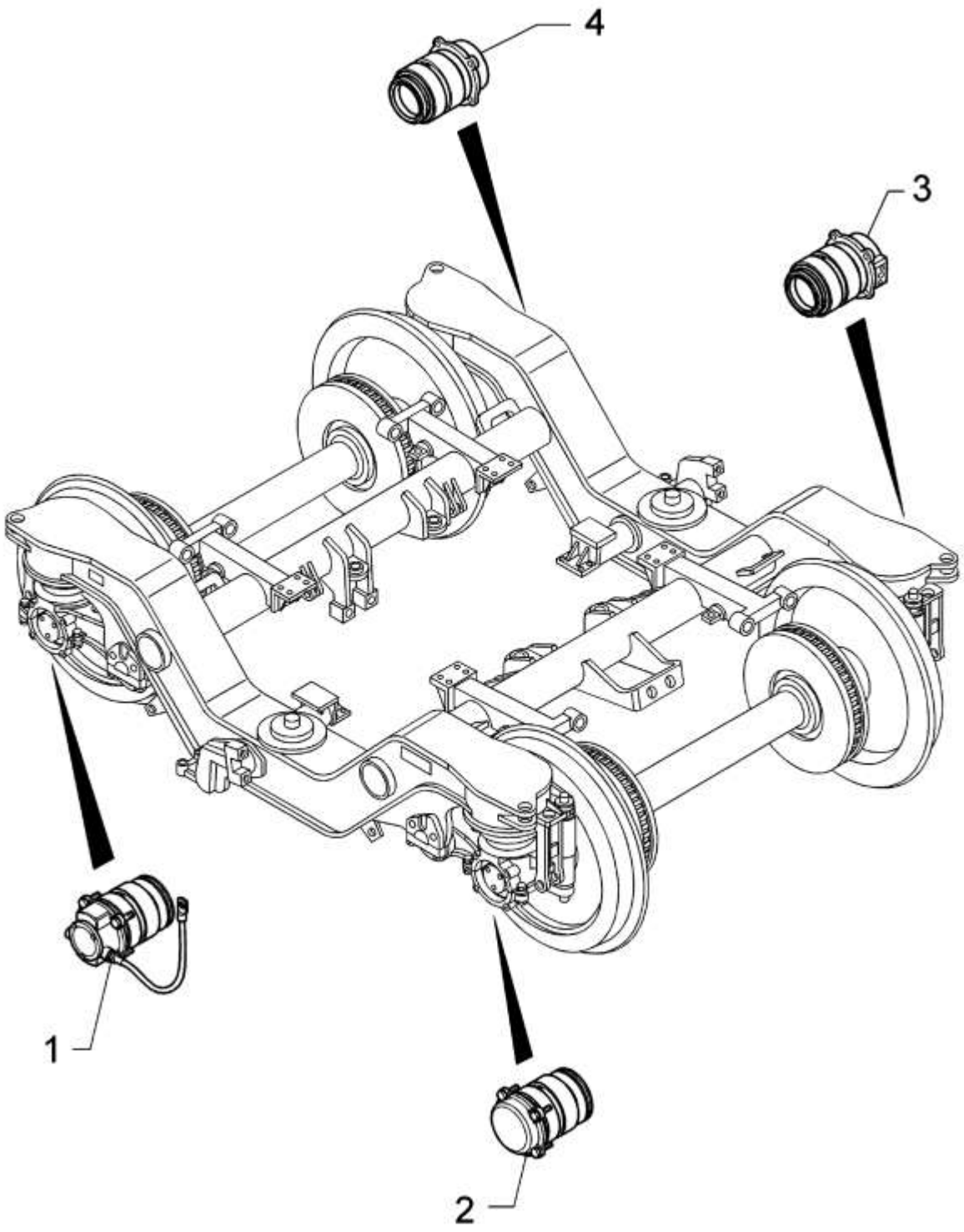
A taper roller cartridge type bearing is used and it makes up a preassembled unit. The axle bearings on the bogie are fitted with sensors for detecting speed (whose signal is elaborated by the anti slipping system) and a current return device.

The ends of the control arms are fitted with centering devices for the primary suspension spring assembly. The bearing lubricating plug is fitted in the lower part.



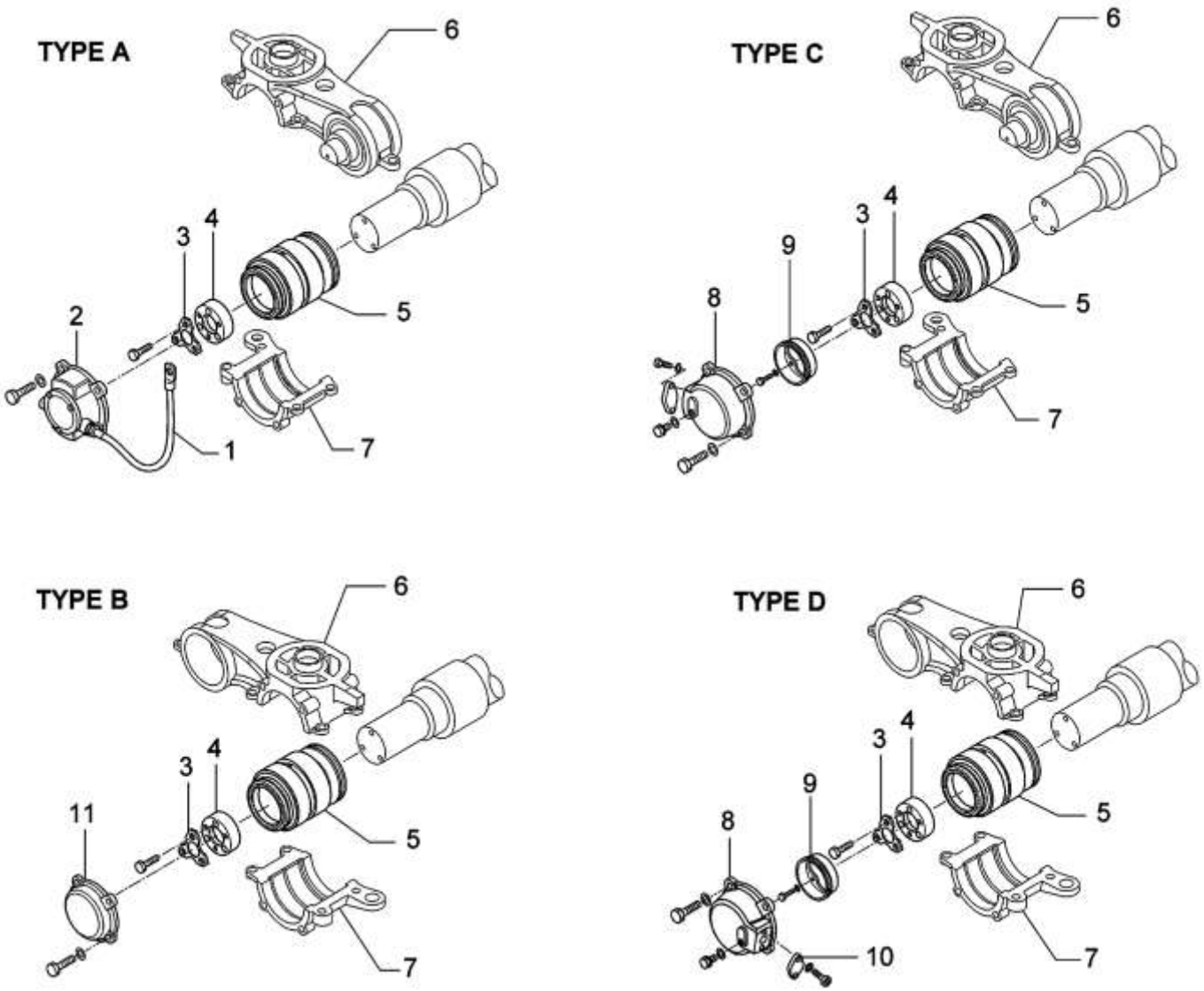
1. Double cup
2. Sealing system
3. Backing ring

FIG. 4-10 Axle Bearing Longitudinal Section



1. Axle bearing with current return device (type A)
2. Axle bearing with no sensor (type B)
3. Axle bearing with phonic cogwheel of antiskid sensor WSP (type C)
4. Axle bearing with phonic cogwheel of antiskid sensor WSP (type D)

FIG. 4.11 Equipment Layout On Bogie Axle Bearing



1. Current return cable
2. Cup
3. Connecting plate
4. Bearing cup
5. Bearing assembly
6. Control arm upper part
7. Control arm lower part
8. Cup
9. Phonic cogwheel of antiskid sensor WSP
10. Cable
11. Cup

FIG. 4-12 Bearing Equipments Installed On the Bogies

4.1.12 Principles of Forces Transmission

Forces concerning the bogie are transmitted as follows.

Vertical forces: from the body to the bogie frame through the secondary suspension springs; from the bogie frame to the axles through the primary suspension springs and frame - axle bearing control arm.

Crosswise forces: from the body to the bogie frame through the secondary suspension springs; from the bogie frame to the axles through the elastic elements of the frame - axle bearing control arm.

Longitudinal traction efforts and braking powers: from the body to bogie frame through the traction centre rods and the traction lever; from the bogie frame to the axles through the frame - axle bearing control arm.

4.2. LIFTING THE BODY

4.2.1 Bogie Disconnection Sequence

n order to disconnect the bogie from the car body, follow this sequence:

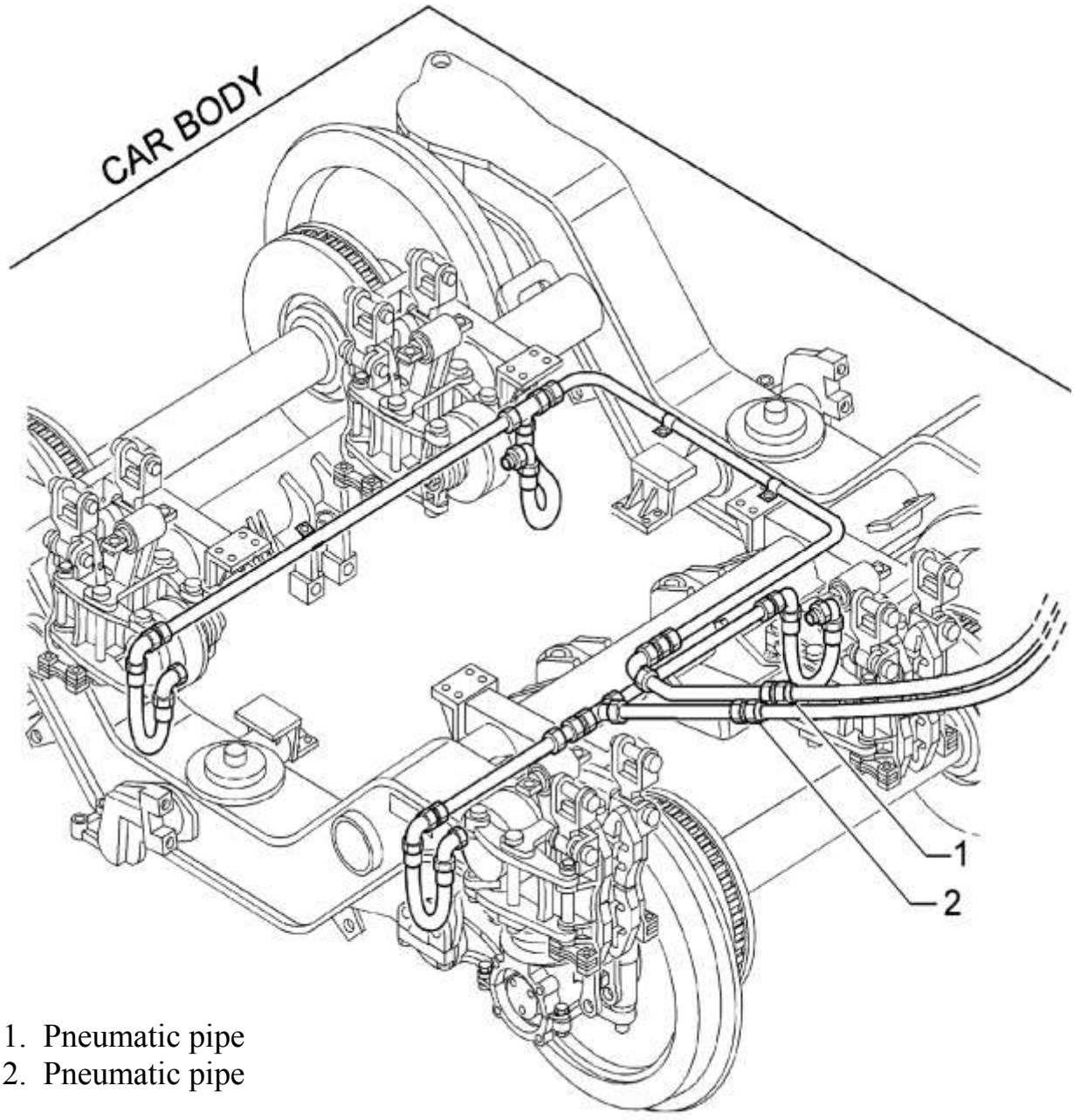
- Disconnect the pneumatic connections of the brakes (see Para. 4.2.2)
- Disconnect the cables of the hand brake (just for bogie 1267334 - see Para. 4.2.3)
- Disconnect the electric cables from the sensors mounted on the axle bearings(see Para. 4.2.4)
- Disconnect the ground cable between coach body and bogie frame (see Para. 4.2.4)
- Disconnect the yaw dampers from the car body supports (see Para. 4.2.5)
- Disconnect the bolster beam from the car bottom (see Para. 4.2.6)
- Lift the car body (see Para. 4.2.7)
- Roll the bogie away (see Para. 4.2.7)

All of these operations are described in details in the following paragraphs.

4.2.2 Disconnection of the Pneumatic Connections of the Brake

WARNING: BE SURE THAT NO PRESSURE IS INSIDE THE PNEUMATIC SYSTEM: DISCHARGE COMPRESSSED AIR BEFORE PROCEEDING

After the pressure inside the system has dropped, disconnect the two pneumatic connections (1 and 2, FIG. 4-13) which supply compressed air to the brake cylinders.

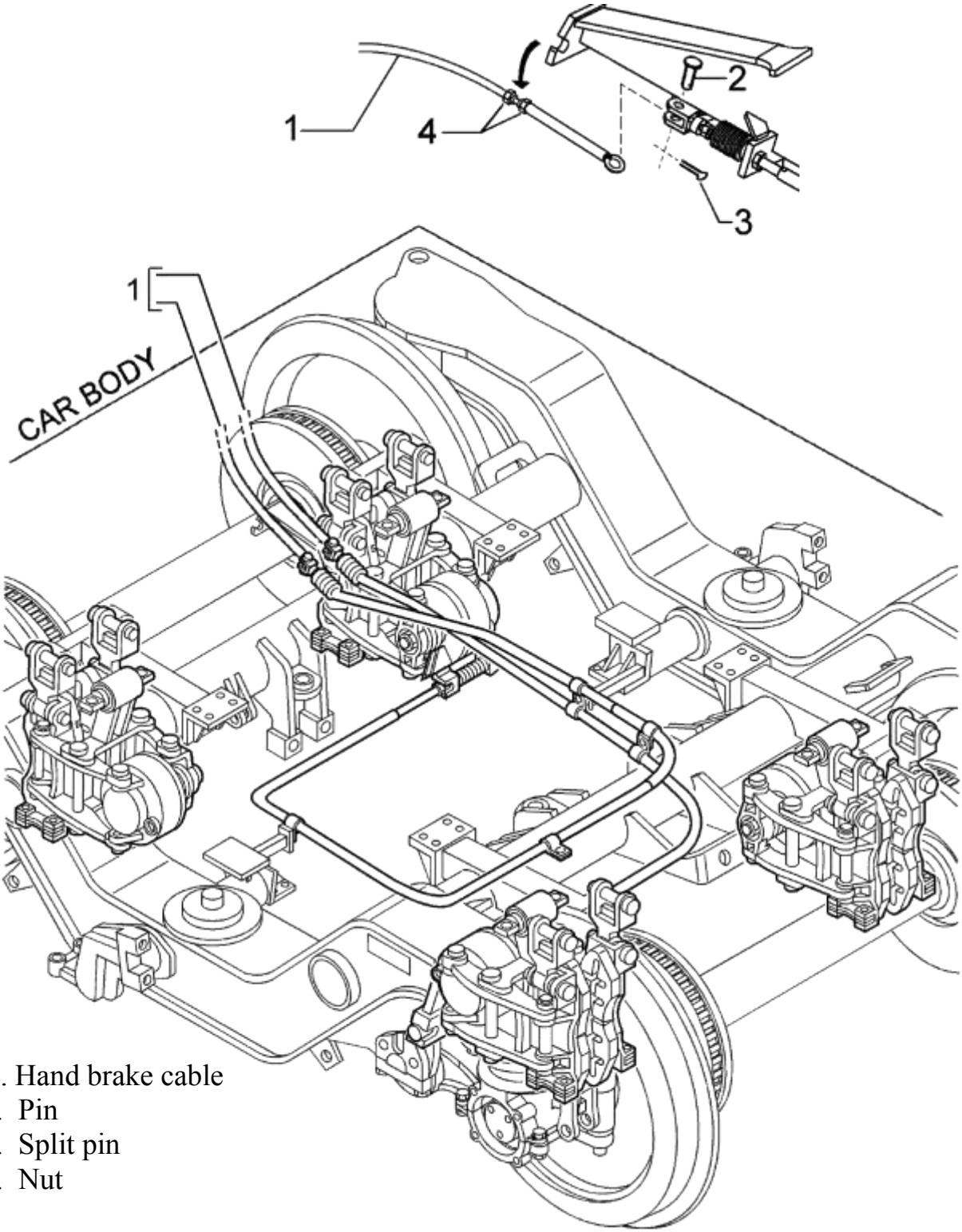


1. Pneumatic pipe
2. Pneumatic pipe

FIG. 4-13 Disconnect Pneumatic Feed Pipes

4.2.3 Disconnection of the Hand Brake Cables (only for Bogie 1267334)

When working on bogie 1267334 it is necessary to disconnect the hand brake cables (1-FIG. 4-14 -after releasing the hand brakes): extract the split pin (3) and the pin (2), then untighten the nuts (4) and remove the cables (1) from the frame support.



1. Hand brake cable
2. Pin
3. Split pin
4. Nut

FIG. 4-14 Disconnections of Hand Break Cables

4.2.4 Disconnect Signal and Ground Cables from the Axle-Bearings Sensors

Disconnect the cables (1, 2 - FIG. 4-15) which link the sensors on the axle-bearings to the coach body equipment, and the ground cable (3) between the coach body and the frame.

1. Speed sensor cable (axle bearing type D)
2. Speed sensor cable (axle bearing type C)
3. Ground cable

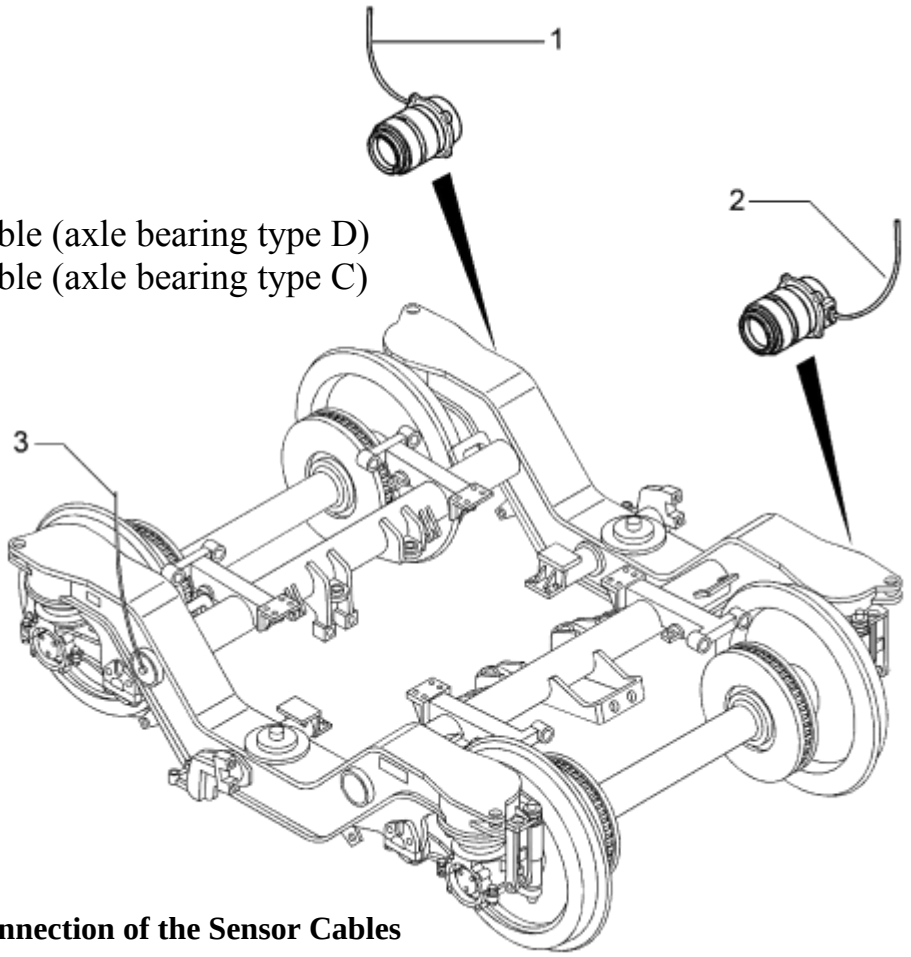


FIG. 4-15 Disconnection of the Sensor Cables

4.2.5 Disconnection of the Yaw Dampers

Disconnect the yaw damper (1 - FIG. 4-16) connected to the car body support(2) Extracting the fixing screws (3)

1. Yaw damper
2. Car body support
3. Screw

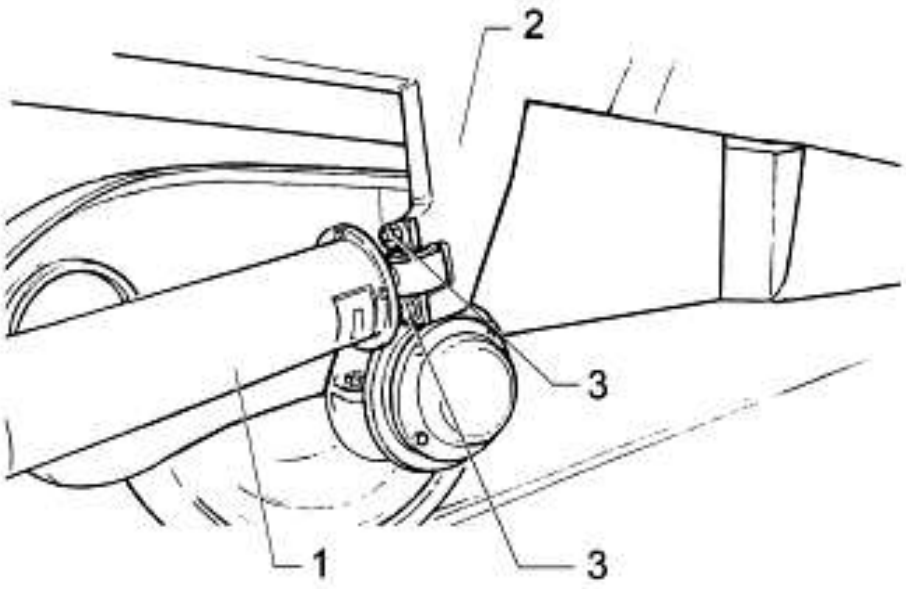
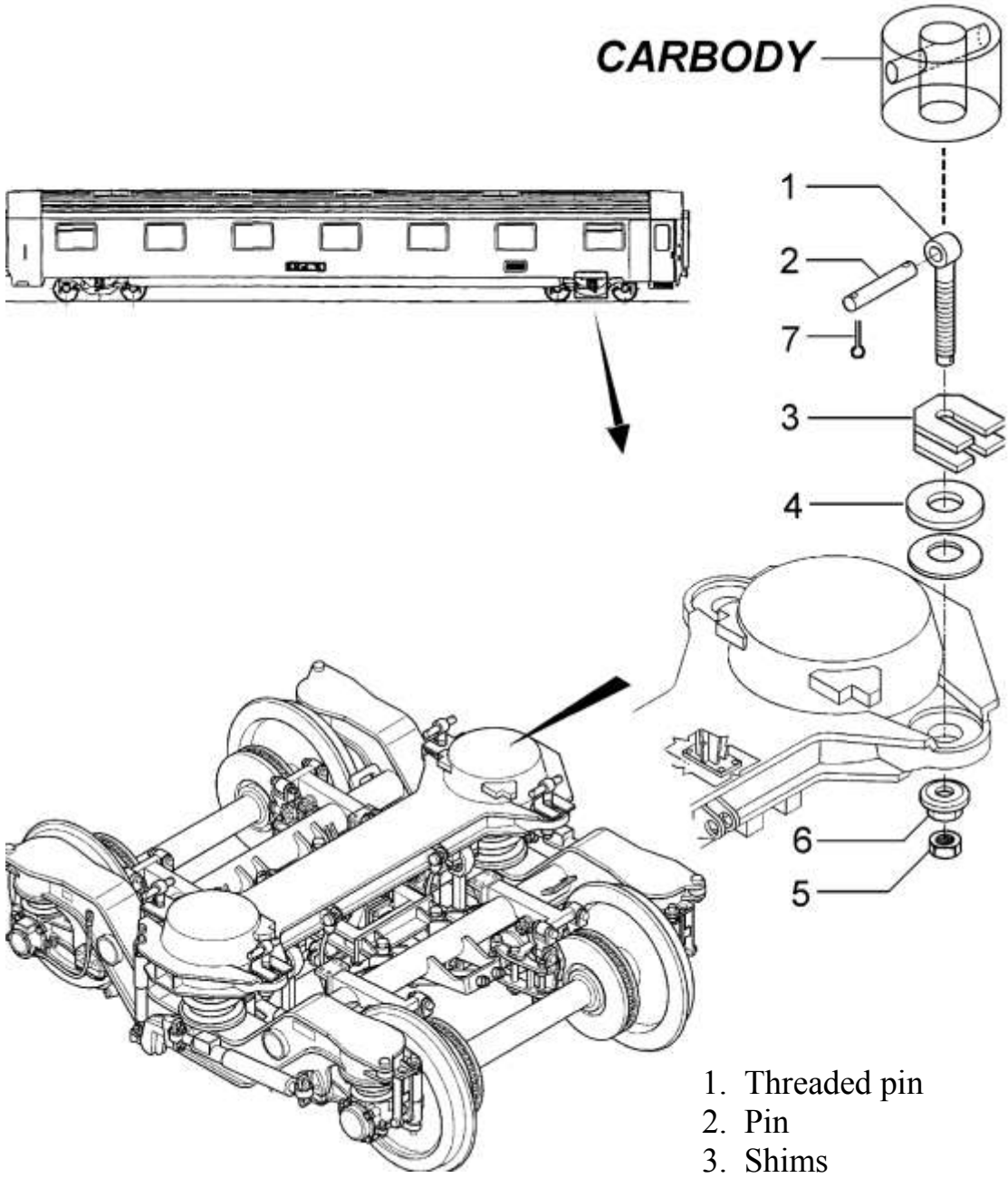


FIG. 4-16 Disconnection of the Yaw Damper

4.2.6 Disconnection of the Bolster Beam from the Car Body

Unscrew the locknut (5 - FIG. 4-17) and the nut linking body and bogie (6). The bogie is disconnected from the car body. When the coach body is lifted, check that washers (4) and shims (3) remain on the bolster beam. Items (1), (2) and (3) remain attached to the coach body: in order to remove them, extract the split pins (7), remove the pin (2) and finally the threaded pin (1).



1. Threaded pin
2. Pin
3. Shims
4. Washer
5. Locknut
6. Nut bogie- car body
7. Split pin

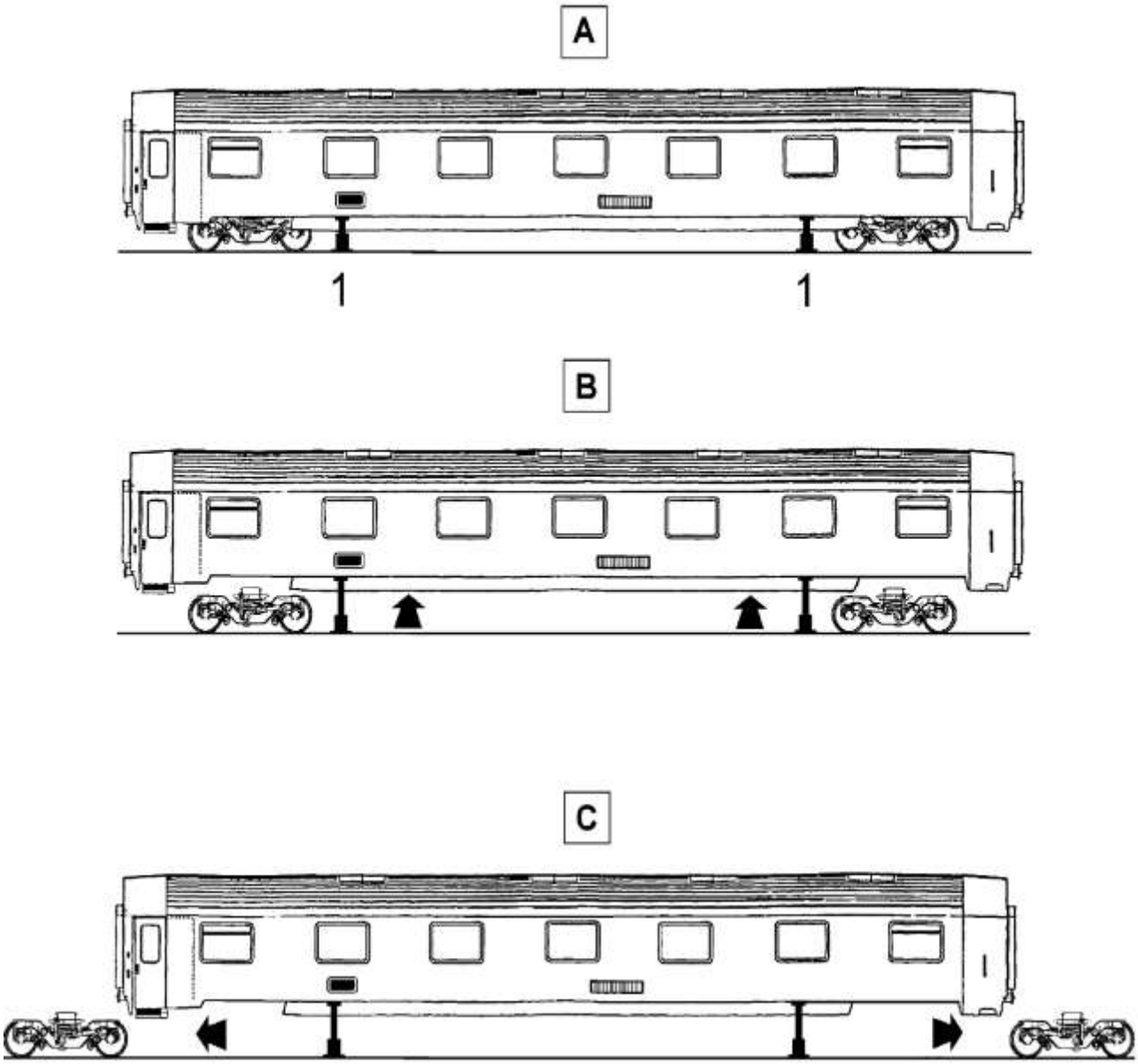
FIG. 4-17 Disconnection of the Bolster Beam

4.2.7 Lifting the Coach Body

After performing the operations described in the previous paragraphs of this chapter, it is possible to remove the bogies from under the car body.

Proceed as follows:

A. Put four hydraulic lifters (1 - FIG. 4-18) under the sides of the car body.
B. Operate the lifters and lift the car body until the bogie bolster beams disengage the car under frame.
C. Roll the bogies away



1. Hydraulic lifters

FIG. 4-18 Removing the Bogie From Under the Car Body

4.3. BOGIE DISASSEMBLY

After having disconnected the bogie from the body, clean it taking into account the following:

A. Do not wash with atomized fuel oil;

B. Before washing with chemical detergents, make sure that they do not damage rubber parts (do not use hydrocarbons);

C. During washing, liquid temperature must be kept below 80 °C;

D. Avoid water jets directed onto axle, bearing cartridge labyrinth rings and into electrical and pneumatic connections.

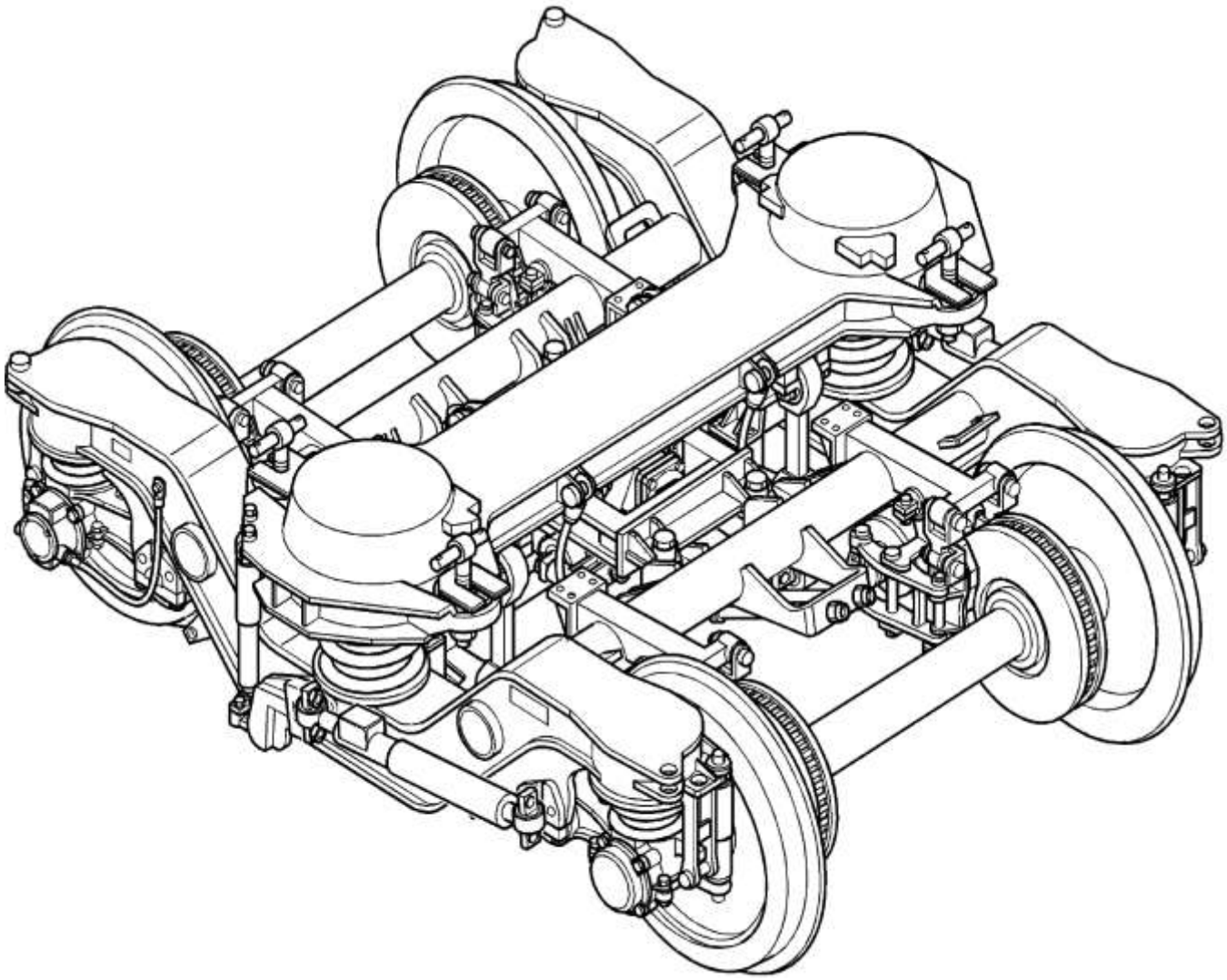


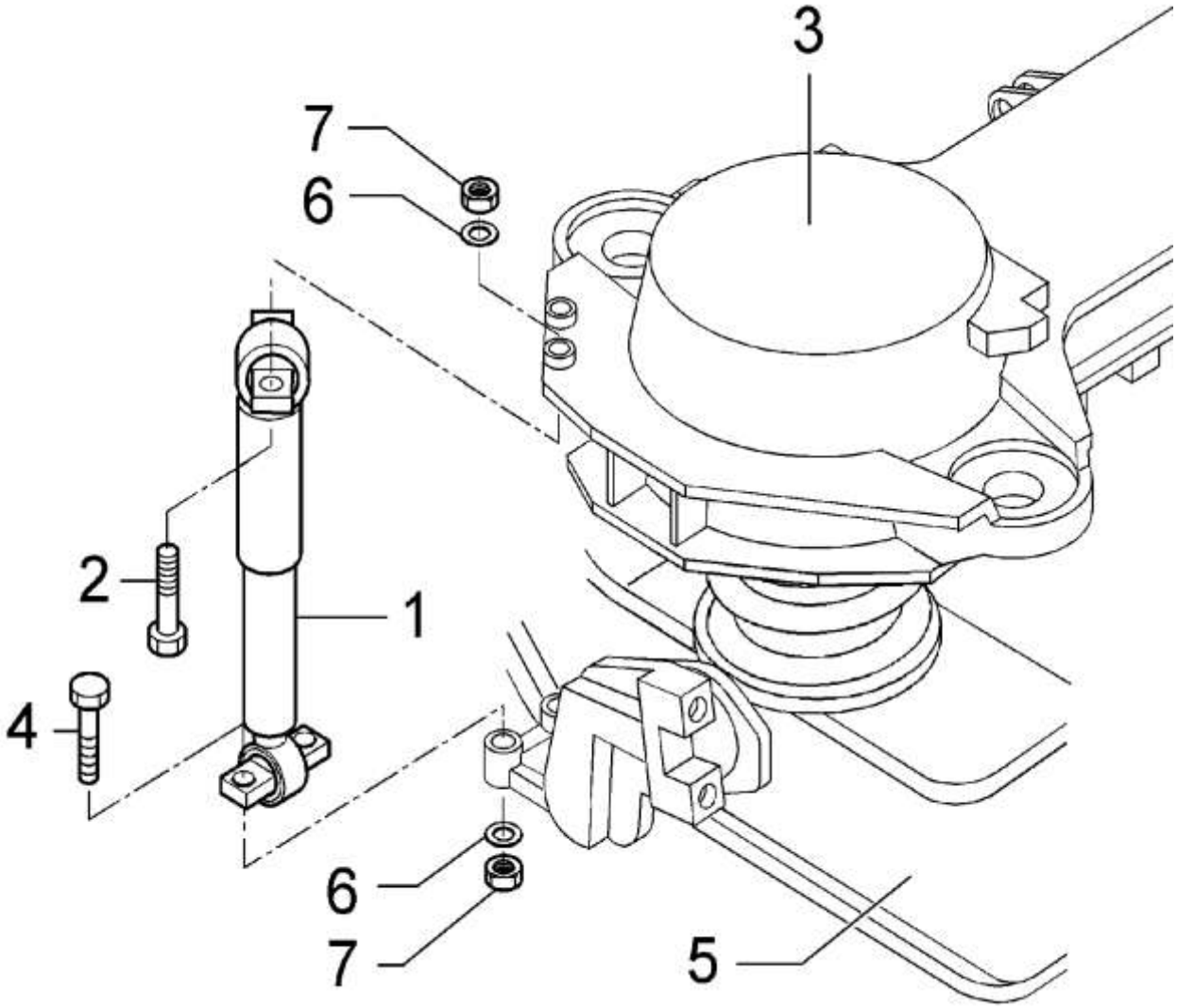
FIG. 4-19 Bogie Disconnected From the Car Body

4.3.1 Secondary Suspension Dismounting

In order to completely remove the secondary suspension from the bogie it is necessary to perform the operations described in the following paragraphs.

4.3.1.1 Vertical and Lateral Dampers Removal

Remove both vertical dampers (1 - FIG. 4.20) extracting the screws (2) which fix the upper end to the bolster beam (3) and those (4) fixing the lower end to the bogie frame (5). In both cases recover the washers (6) and the nuts (7).



1. Vertical damper
2. Upper screw
3. Bolster beam
4. Lower screw
5. Bogie frame
6. Washer
7. Nut

FIG. 4.20 Vertical Damper Removal

Remove the lateral damper (1 - FIG. 4.21) extracting the screws (2) which fix one end at the bolster beam (3) and the other to the frame. Recover the washers (4) and the nuts (5).

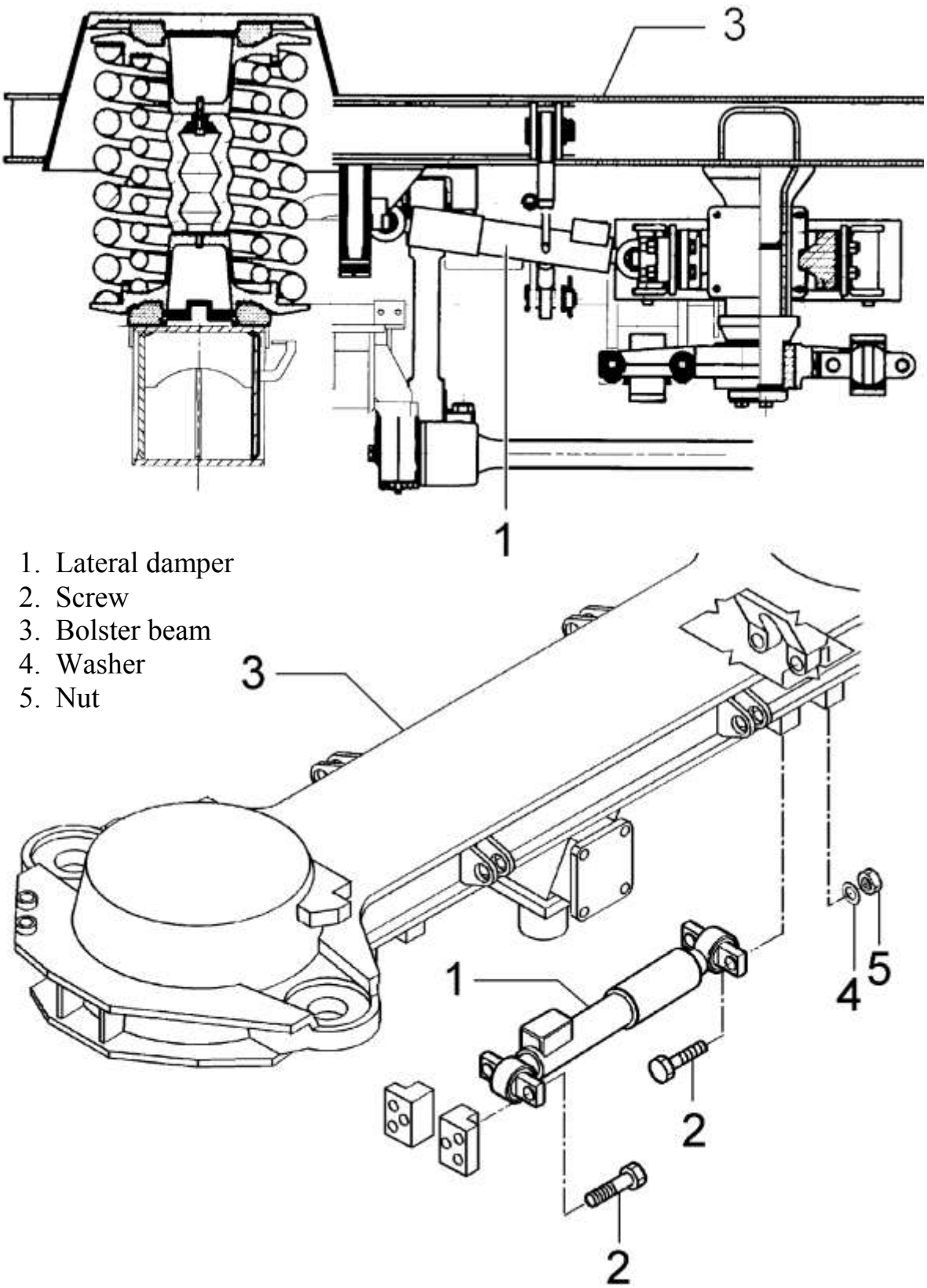


FIG. 4.21 Lateral Damper Removal

4.3.1.1.1 PERIODICAL INSPECTION AND GENERAL MAINTENANCE OF DAMPERS

Visual inspection

The in service environment exposes Railway dampers to dirt and oil from outside sources. Road dirt accumulation covering the entire outer surface of the damper is normal and there will have no adverse effects on the damper"s performance.

Inspection on oil leakage

Sometimes new dampers can appear to show a little oil lost during the first service period and as a result are suspected of leakage. In almost all cases this is assembly lube which has nothing to do with oil leakage.

Assembly oils are yellow or black in colour, and can be easily distinguished from the red hydraulic damping fluid. When the damper is new, the assembly lube may cause a slightly moist rod or body. If this occurs, simply wipe off the excess oil and return the damper to service. If a new damper has red oil droplets, the damper should not be installed but returned under warranty.

For a long service life, it is necessary for the rod oil seal to remain lubricated. The continuous inward and outward movement of the piston rod may cause oil "sweat" from the rod oil seal. This loss of oil can be recognized by the outside of the damper being slightly moist and dirty. However, there are no droplets of oil clinging to the damper. A slight oil sweating will not affect the damping force and this damper may remain in service.

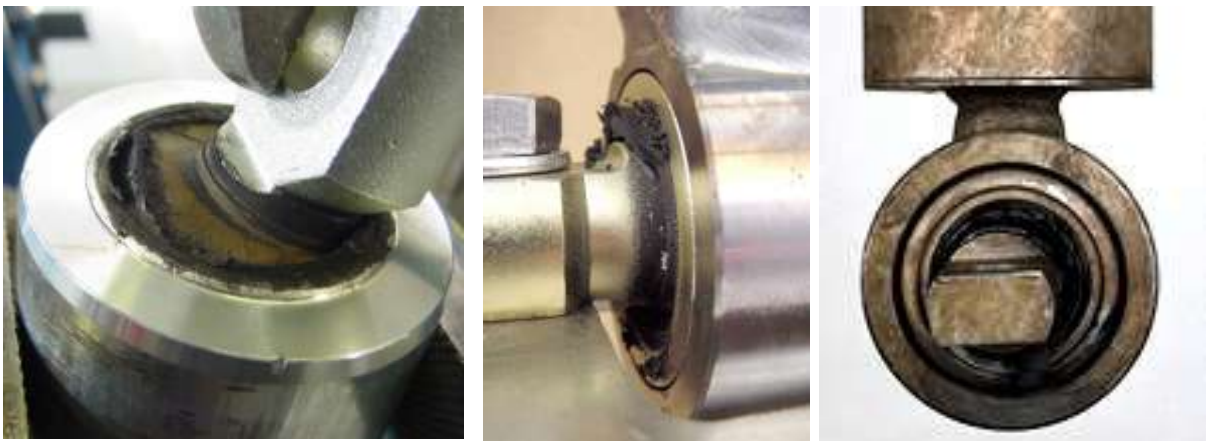
The following criteria can be used during the execution of the visual inspection of the dampers.

VISUAL APPEARANCE	ACTION	PICTURE
Dirt Normal contamination caused by the operating environment of the dampers is harmless. If a damper has a damp film over the whole body (including the dust cover), it is very probable that this is the result of an outside source of oil or dirt. In this case the damper can remain in service.	None None	

VISUAL APPEARANCE	ACTION	PICTURE
Sweating For a long service life, it is necessary for the rod oil seal to remain lubricated. The continuous inward and outward movement of the piston rod may cause oil "sweat" from the rod oil seal. This loss of oil can be recognized by the outside of the damper being slightly moist and dirty. However, there are no droplets of oil clinging to the damper. A slight oil sweating will not affect the damping force and this damper may remain in service.	None	
Oil drops A strong oil leakage becomes apparent by a damp surface, which usually covers a large part of the reservoir tube. Isolated oil drop formation is possible. When wiping the absorber with a paper cloth, clear oil stains are visible.	Replacement	

Attachments

It is important to visually check the condition of all rubber attachments. Worn or deteriorated bushings may affect the damper"s performance and cause internal damage to the damper. Bushings should be replaced when the rubber develops a cut or a split. If the bushing has only developed small cracks on the surface of the rubber, no action is necessary. If the bushing is deteriorated or the pin is loose in the bushing, the damper must be removed and the bushing replaced.



Examples of worn bushings

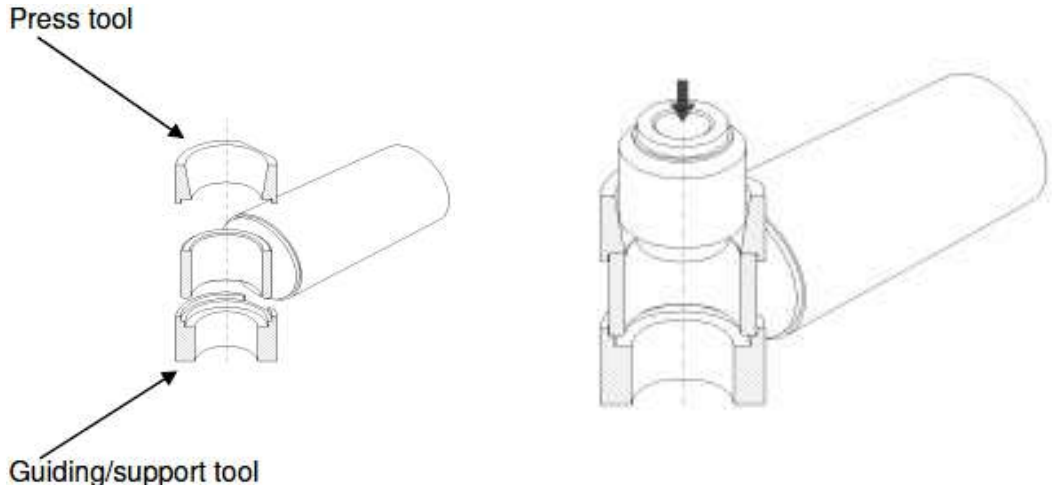
While inspecting the bushings, it is a good idea to examine any welds between the bushing eye and the damper body. The welds should show no evidence of cracking or deterioration.

Replacement of pin attachment rubbers

In case of pin attachments, such as damper 90-2729, the rubbers can simply be replaced without the requirement of special tools.

Replacement of silent blocks

In case of a worn silent block, the complete part has to be removed from the damper eye. Since these attachments are locked in the eye by means of a press fitting, they can only be removed or assembled by means of a pressing tool and a press.
Apply grease to the attachment and the eye before pressing it in. This will prevent damage to the metal parts.

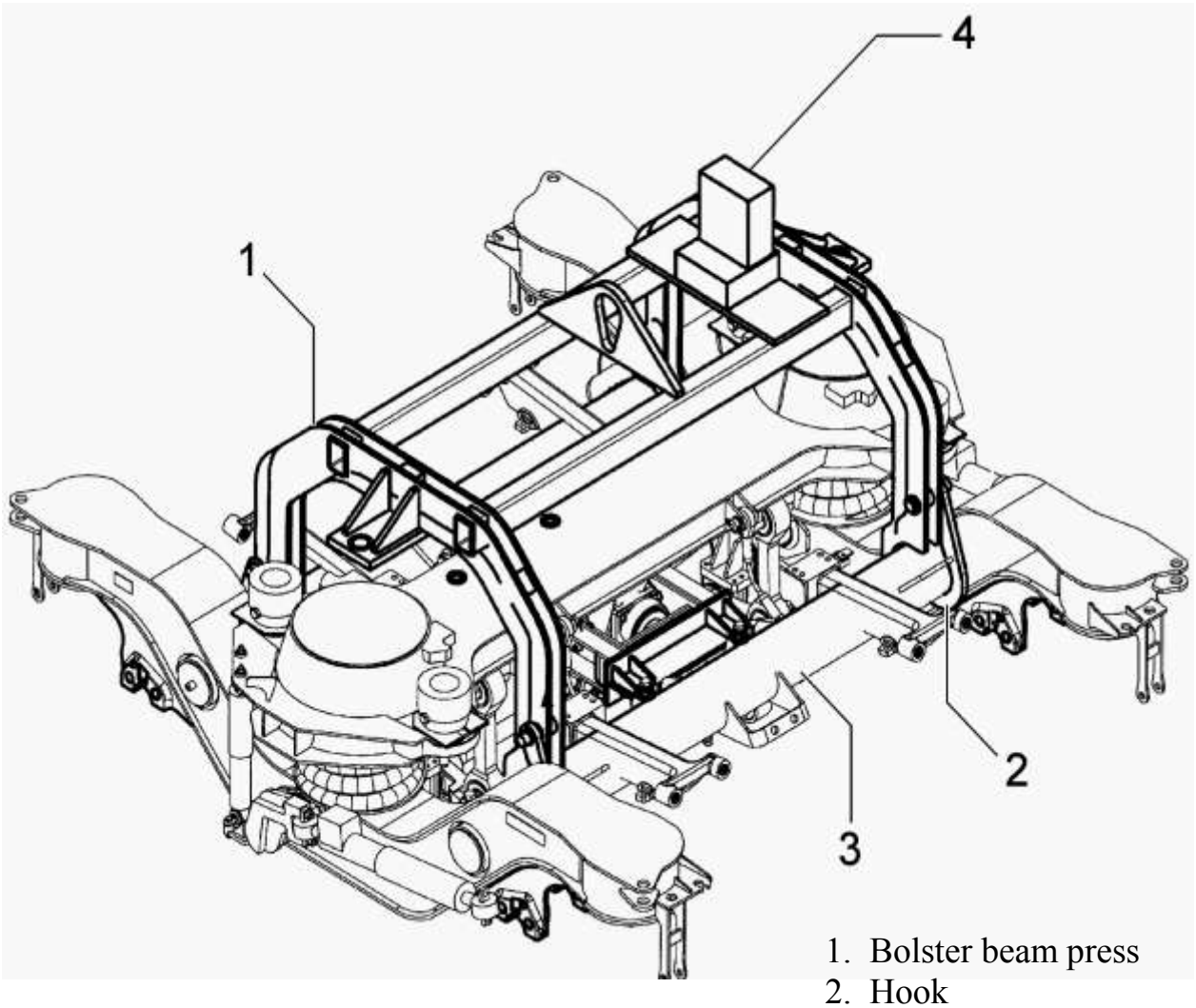


Assembly and removal of silent blocks

4.3.1.2 Pressing the Bolster Beam

The separation of the bolster beam from the traction centre (Para. 4.3.1.3), from the anti-roll bar (Para. 4.3.1.4) and the removal of the safety cables (Para. 4.3.1.5) requires the use of the press 2613037500 (1 - FIG. 4.22). The press is secured to the brake support beam (3) through the hooks (2).

Note: For details of Press, please refer to FIAT drg. No. 2613037500

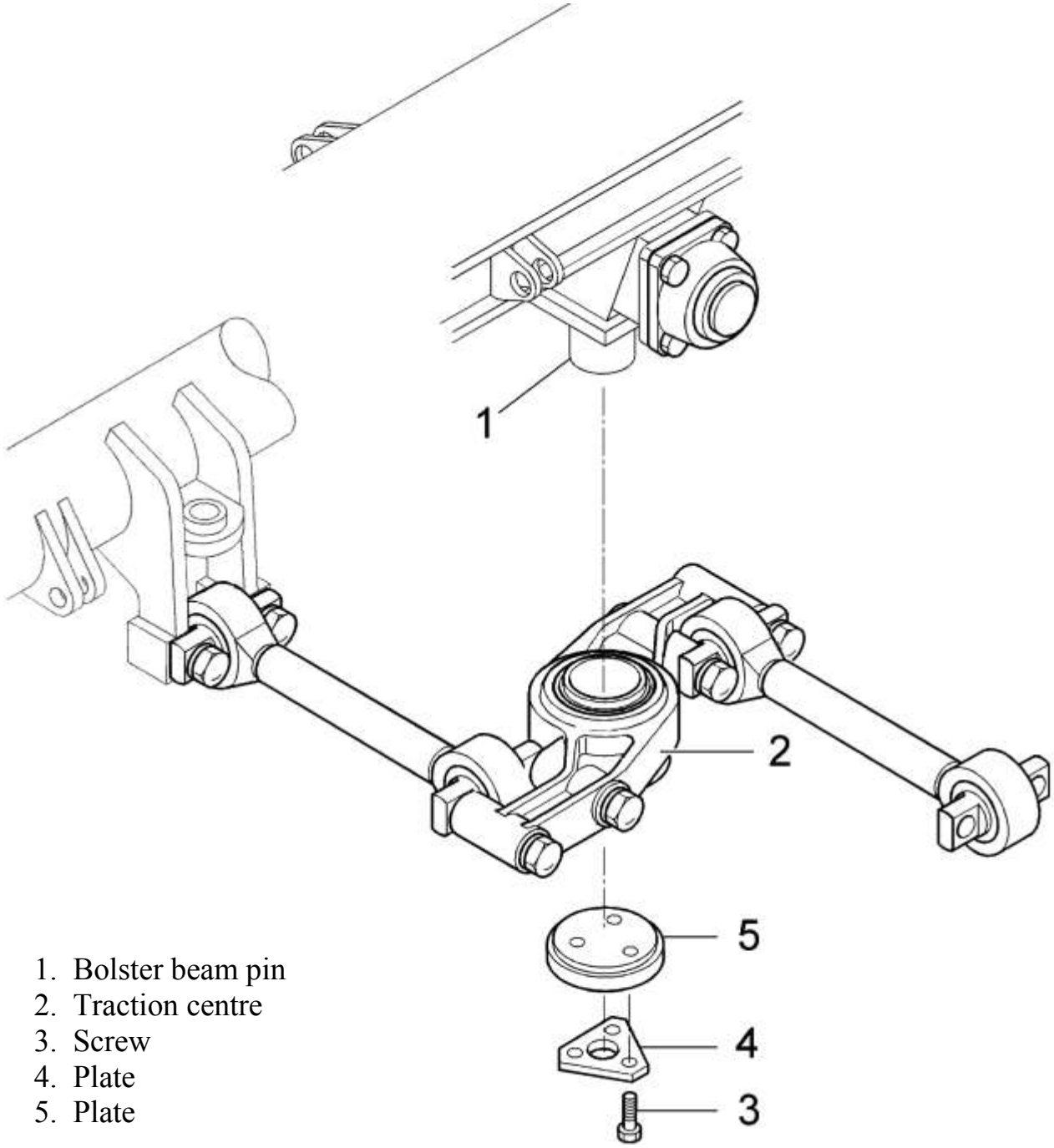


1. Bolster beam press
2. Hook
3. Brake support beam
4. Compressor

FIG. 4.22 Pressing the Bolster Beam

4.3.1.3 Disconnect Bolster Beam from Traction Centre

After pressing the bolster beam, as described in para. 4.3.1.2, disconnect the bolster beam central pin (1 - FIG. 4.23) from the traction centre (2): extract the screws (3) which fix the plates (4) and (5).



1. Bolster beam pin
2. Traction centre
3. Screw
4. Plate
5. Plate

FIG. 4.23 Disconnection from the Traction Centre

After disconnection, verify that the traction centre (2) complete with its rubber bush is free against the bolster beam pin (1).

4.3.1.4 Remove the Anti-Roll Bar

The anti-roll bar (1 - FIG. 4.24) must be disconnected both from the bolster beam (2) and from the frame supports (3) in order to allow removal. Extract the screws (4) which link the anti-roll bar links (5) to the bolster beam, then extract those (6) fixing the brackets (7) to the frame supports (3). It is then possible to remove the complete anti-roll bar (1).

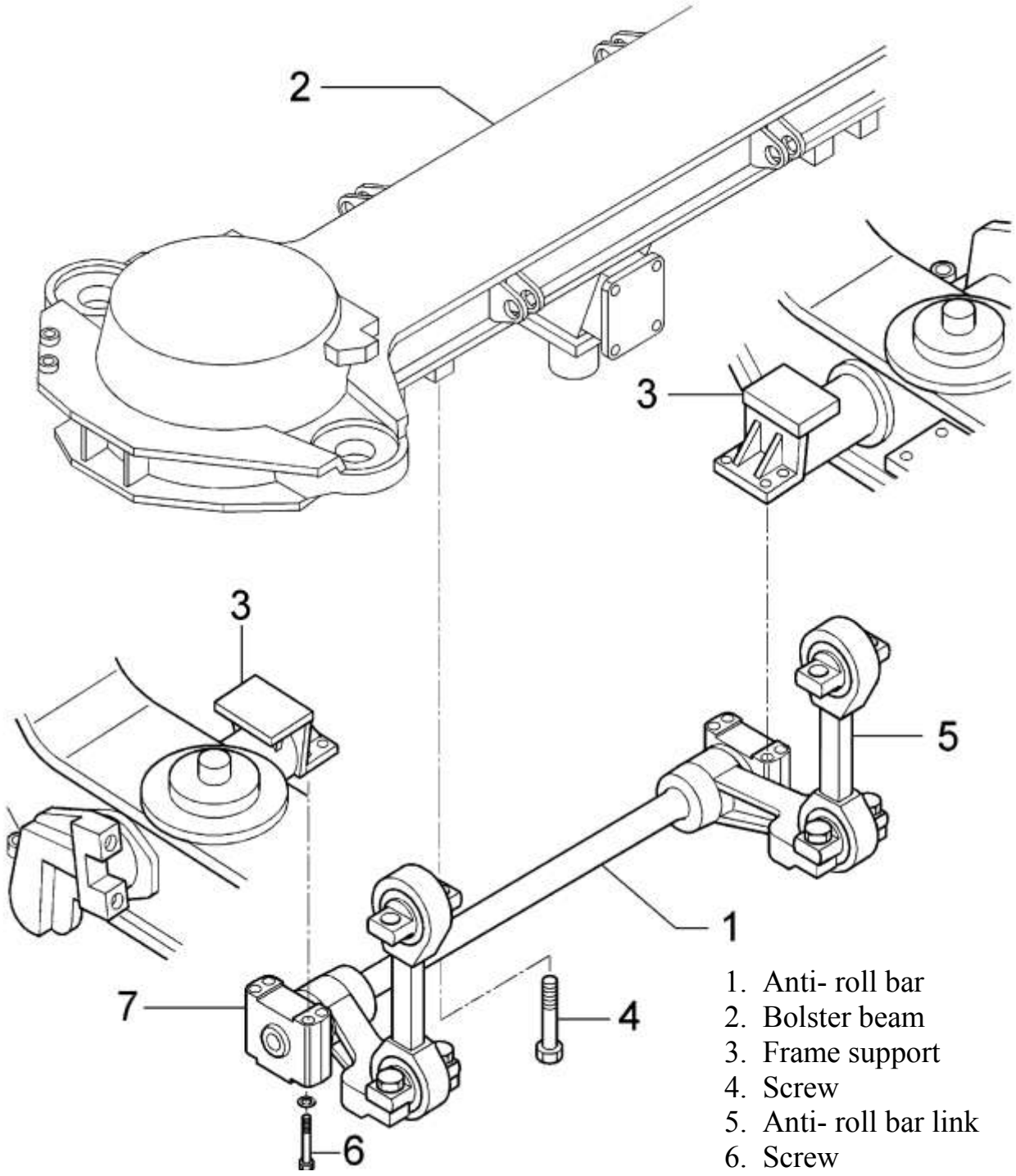


FIG. 4.24 Removal of the Anti- Roll Bar

4.3.1.5 Remove Safety Cables

In order to remove the four safety cables (1 - FIG. 4.25) which link the bolster beam to the bogie frame, extract the split pins (2), extract the pins (3) from both ends and recover the washers (4).

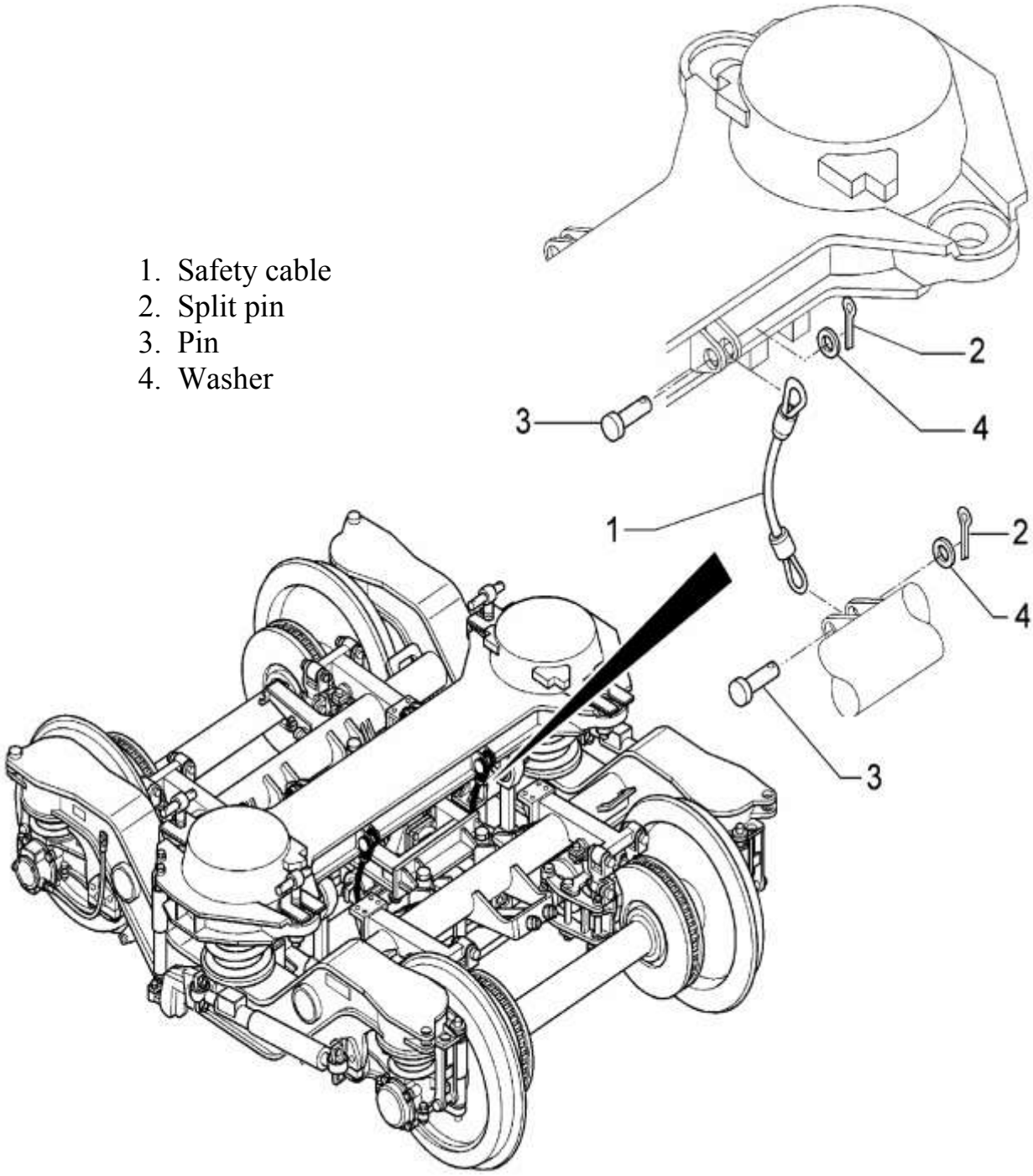


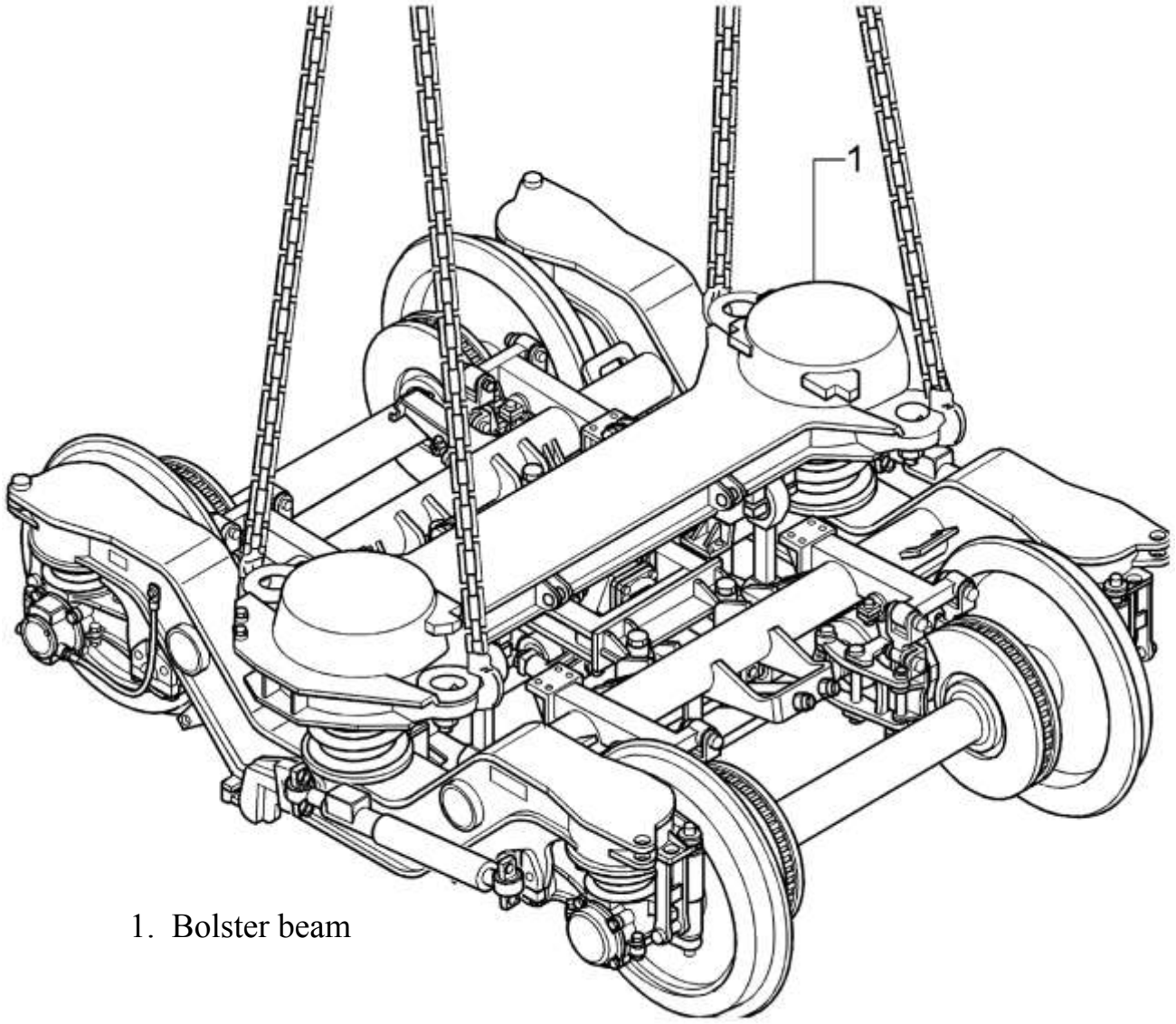
FIG. 4.25 Safety Cables Removal

4.3.1.6 Lifting the Bolster Beam

After performing the operations described in the previous paragraphs, it is possible to remove the bolster beam (1 - FIG. 4.26) from the bogie by lifting it using proper crane equipment.

WARNING: ***PAY ATTENTION WHEN LIFTING THE BOLSTER BEAM IN ORDER TO AVOID ANY INJURY TO PERSONNEL, ANY PEOPLE NOT INVOLVED IN THE OPERATION MUST STAY AWAY FROM THE WORKING AREA. TAKE CARE NOT TO DAMAGE THE BOLSTER BEAM SURFACE WHEN OPERATING. PAY ATTENTION THAT NO UPPER DISC OR RING OF THE SECONDARY SUSPENSION REMAINS ATTACHED TO THE BOLSTER BEAM: IT COULD BE DANGEROUS IF THEY SHOULD FALL AFTER LIFTING.***

Link the crane equipment to the bolster beam and begin lifting it with care



1. Bolster beam

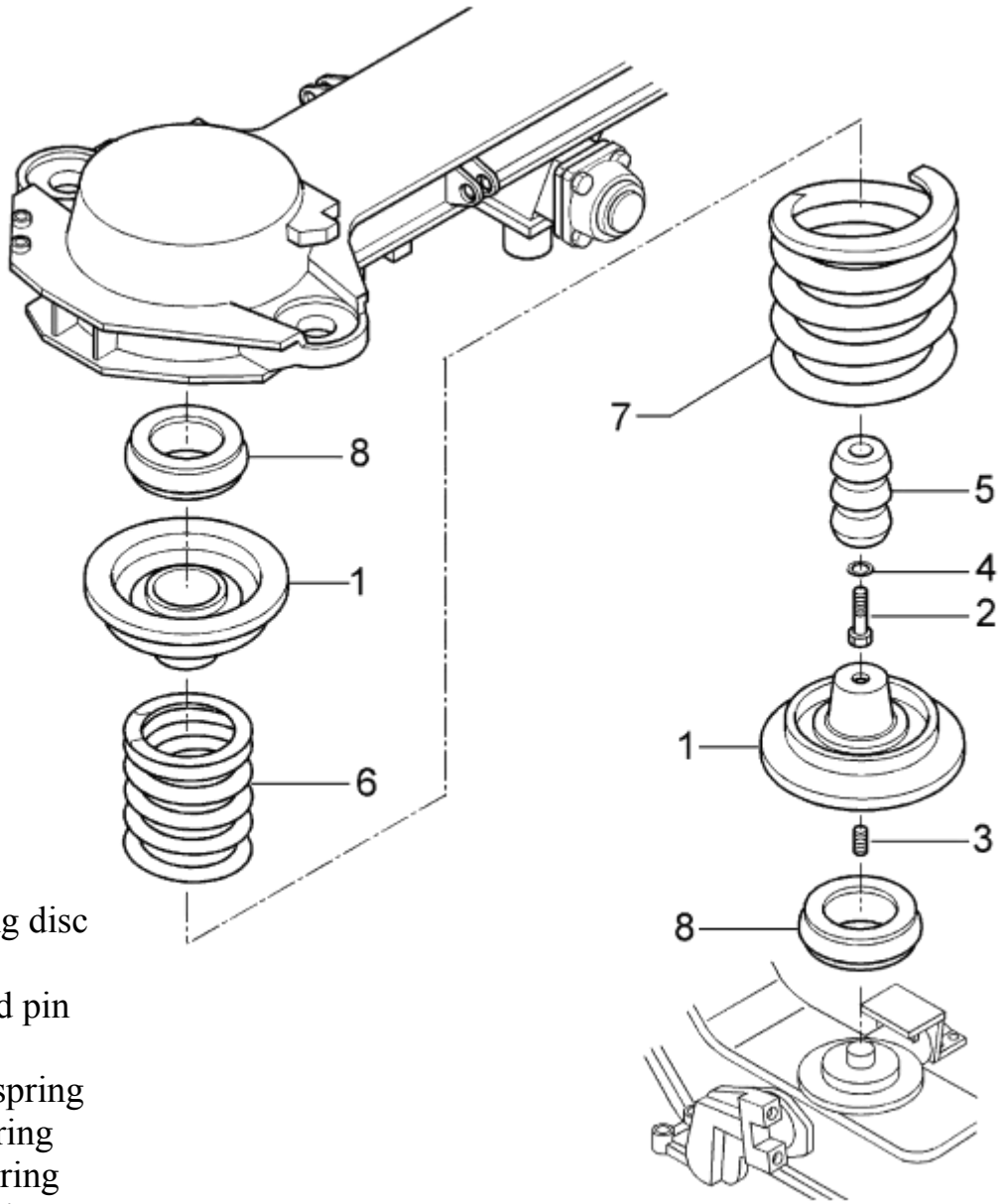
FIG. 4.26 Bolster Beam Removal

Before removing springs, take note of the following:

- Mark each couple of inner / outer spring
- Take note of which bogie each couple is mounted on

The above procedure is needed to mount again the springs in the same position and location they were before removal.

The spring packs (FIG. 4.27) of the secondary suspension can then be dismounted in the following manner: remove the upper rubber ring (8). Remove the upper centering disc (1) together with the rubber spring (5), the washer (4) and the screw (2). Extracting the screw (2) it is possible to separate items (1), (2) and (5). Then it is possible to remove the inner spring (6), the outer spring (7). Extract the threaded pin (3) in order to remove the lower centering disc (1) and the lower rubber ring (8). Then put the bolster beam on two supports.

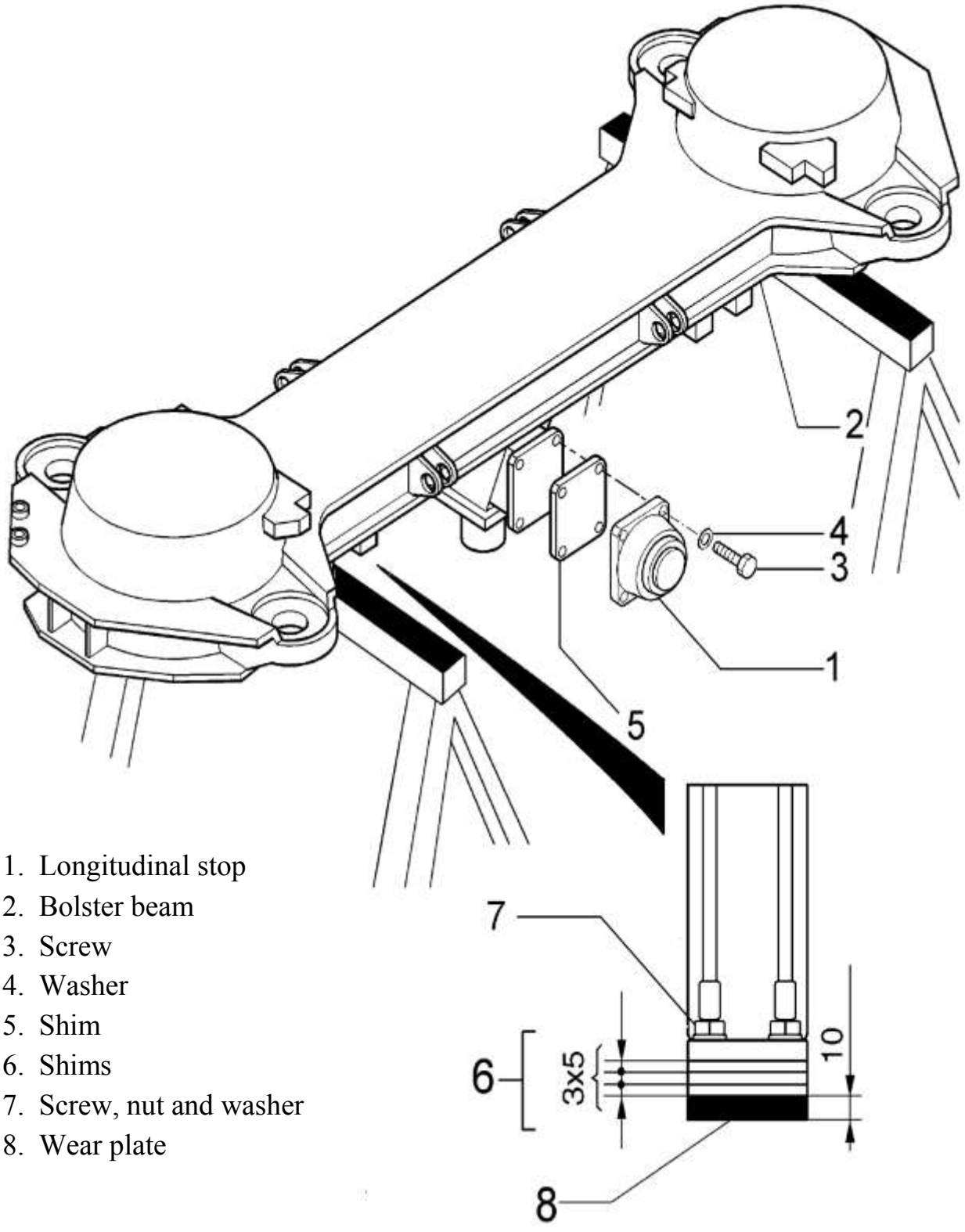


1. Centering disc
2. Screw
3. Threaded pin
4. Washer
5. Rubber spring
6. Inner spring
7. Outer spring
8. Rubber ring (MINER PAD)

FIG. 4.27 Springs Pack Dismounting

It is finally possible to remove the longitudinal bump stops (1 - FIG. 4.28) and the shims (5) from the bolster beam (2), extracting the screws (3) and the washers (4).

Remove the shims (6) and the wear plate (8) under the bolster beam extracting the screws, nut and washers (7).



1. Longitudinal stop
2. Bolster beam
3. Screw
4. Washer
5. Shim
6. Shims
7. Screw, nut and washer
8. Wear plate

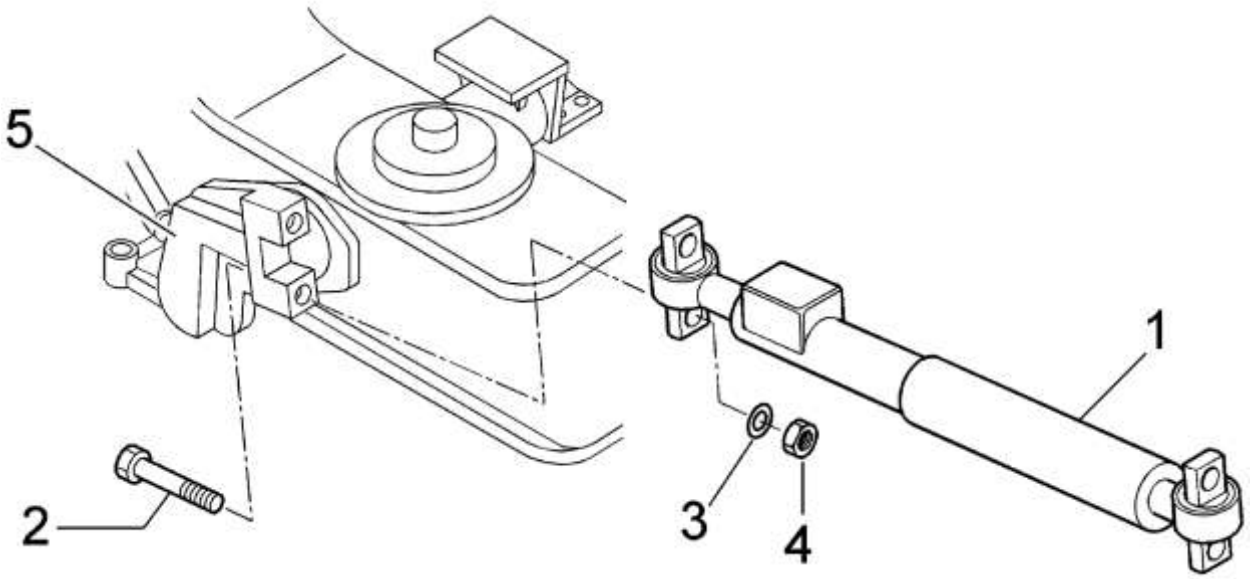
FIG. 4.28 Removing Bump Stops and Shims from the Bolster Beam

4.3.2 Dismounting Assemblies from the Frame

On the bogie frame without the bolster beam it is possible to remove its main assemblies.

4.3.2.1 Removal of Yaw Dampers

In order to remove the yaw dampers (1 - FIG. 4.29), extract the screws (2), the washers (3) and the nuts (4) which fix their ends to the bogie frame side supports (5).



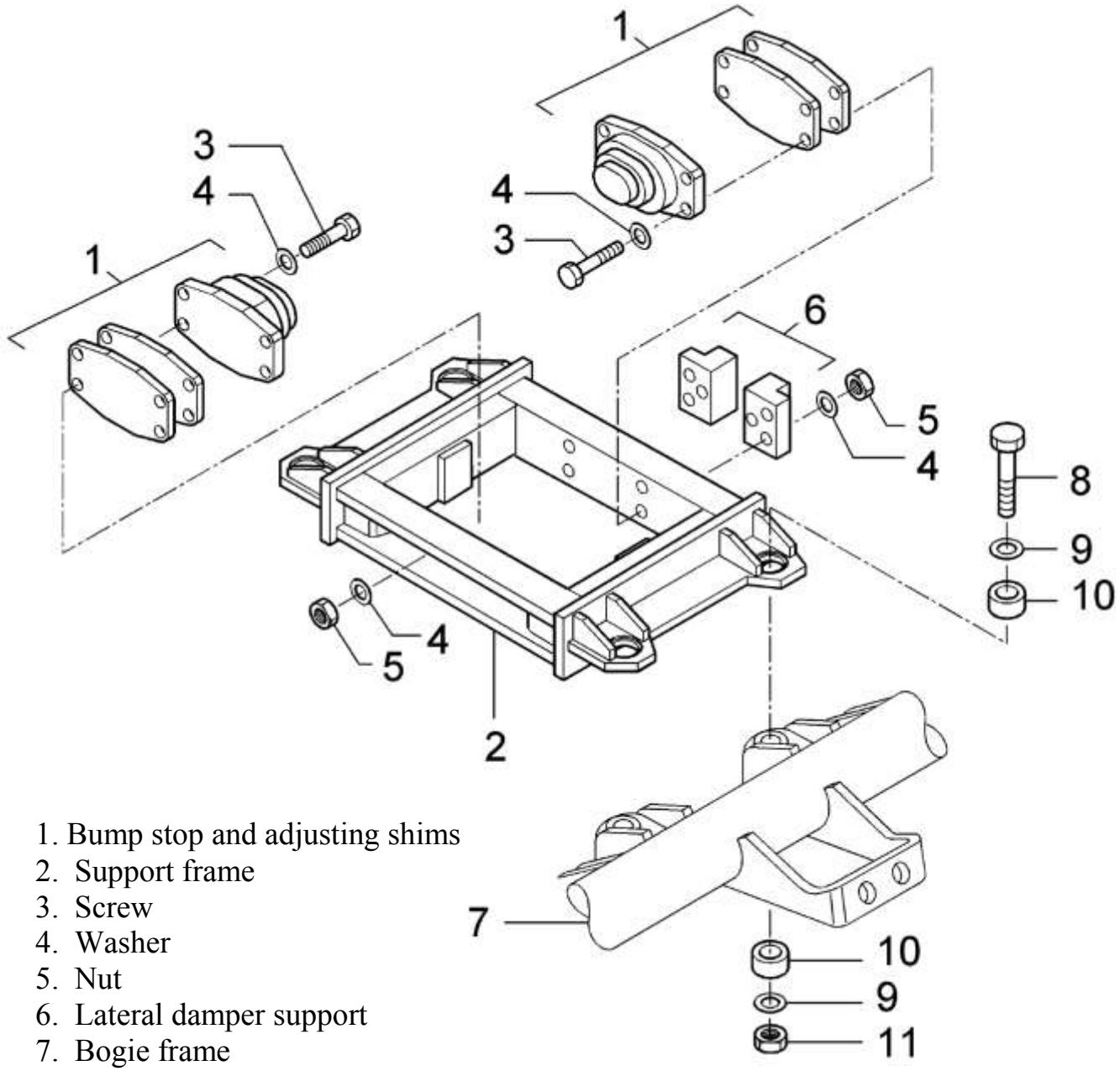
1. Yaw damper
2. Screw
3. Washer
4. Nut
5. Frame support

FIG. 4.29 Removing a Yaw Damper

4.3.2.2 Removal of Lateral Bump Stops

Remove the lateral bump stops (1 - FIG. 4.30) from the frame (2) extracting the screws (3), the washers (4) and the nuts (5). When dismounting them, also the support (6) for the lateral damper can be removed.

Then proceed with dismounting the frame (2) from the bogie frame (7), extracting the screws (8), the washers (9), the discs (10) and the nuts (11).



1. Bump stop and adjusting shims
2. Support frame
3. Screw
4. Washer
5. Nut
6. Lateral damper support
7. Bogie frame
8. Screw
9. Washer
10. Disc
11. Nut

FIG.4.30 Removing Bump Stops From the Bogie Frame

4.3.2.3 Dismounting the Traction Centre

In order to dismount the traction centre (FIG. 4.31), disconnect the rods (1) from the bogie frame (2), extracting the screws (3), the washers (4) and the nuts (5). Then separate the rods (1) from the traction lever (6) extracting the screws (7), the washers (8) and the nuts (9). Then extract the bush (10) from the traction lever (6) using a press.

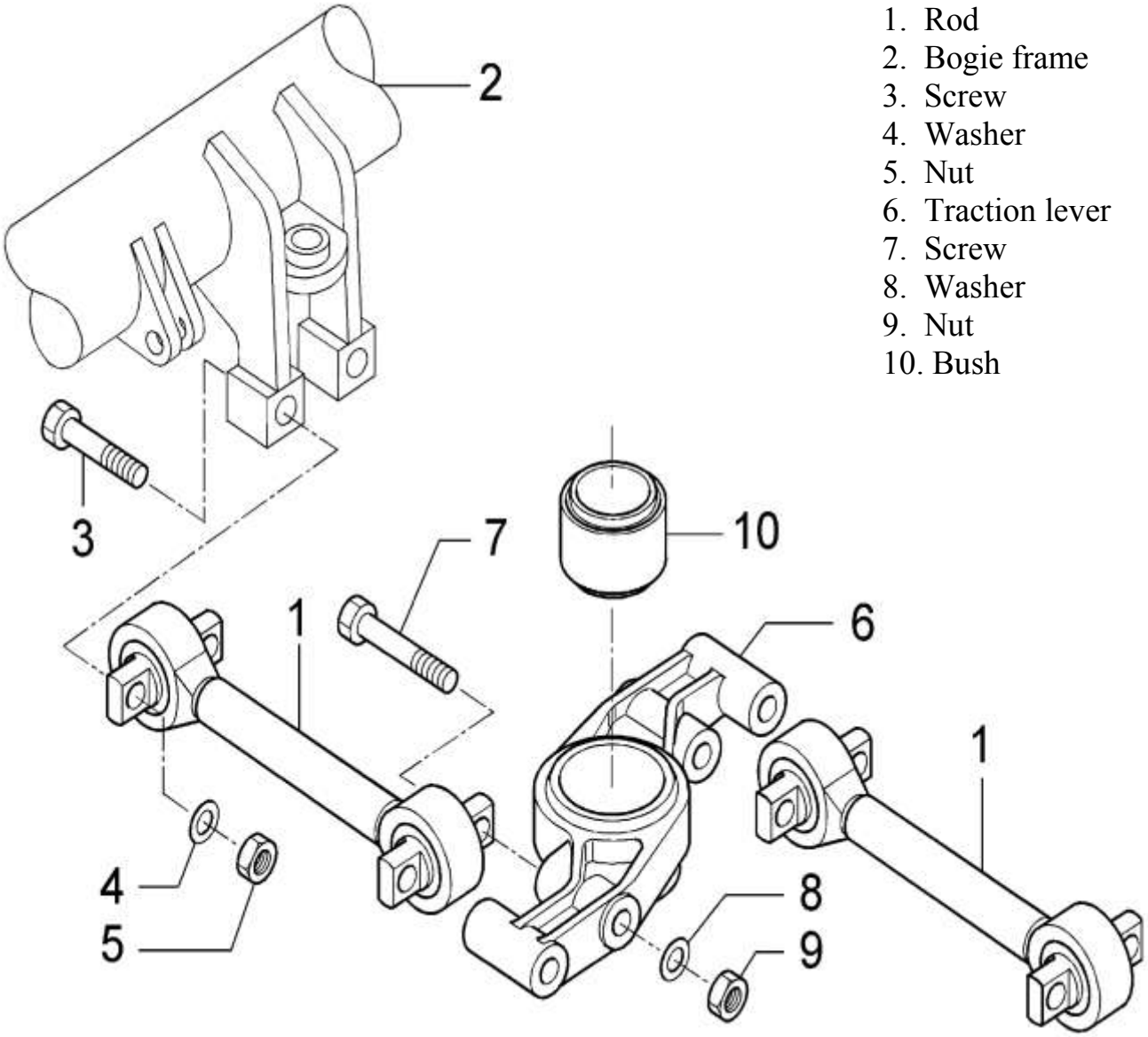


FIG. 4.31 Dismounting the Traction Centre

4.3.2.4 Dismounting Corner Rolls

Remove the two rolls (1 - FIG. 4.32) at the outer corners of the bogie frame: extract the split pin (4) and remove the washer (3) and the pin (2).

1. Roll
2. Pin
3. Washer
4. Split pin

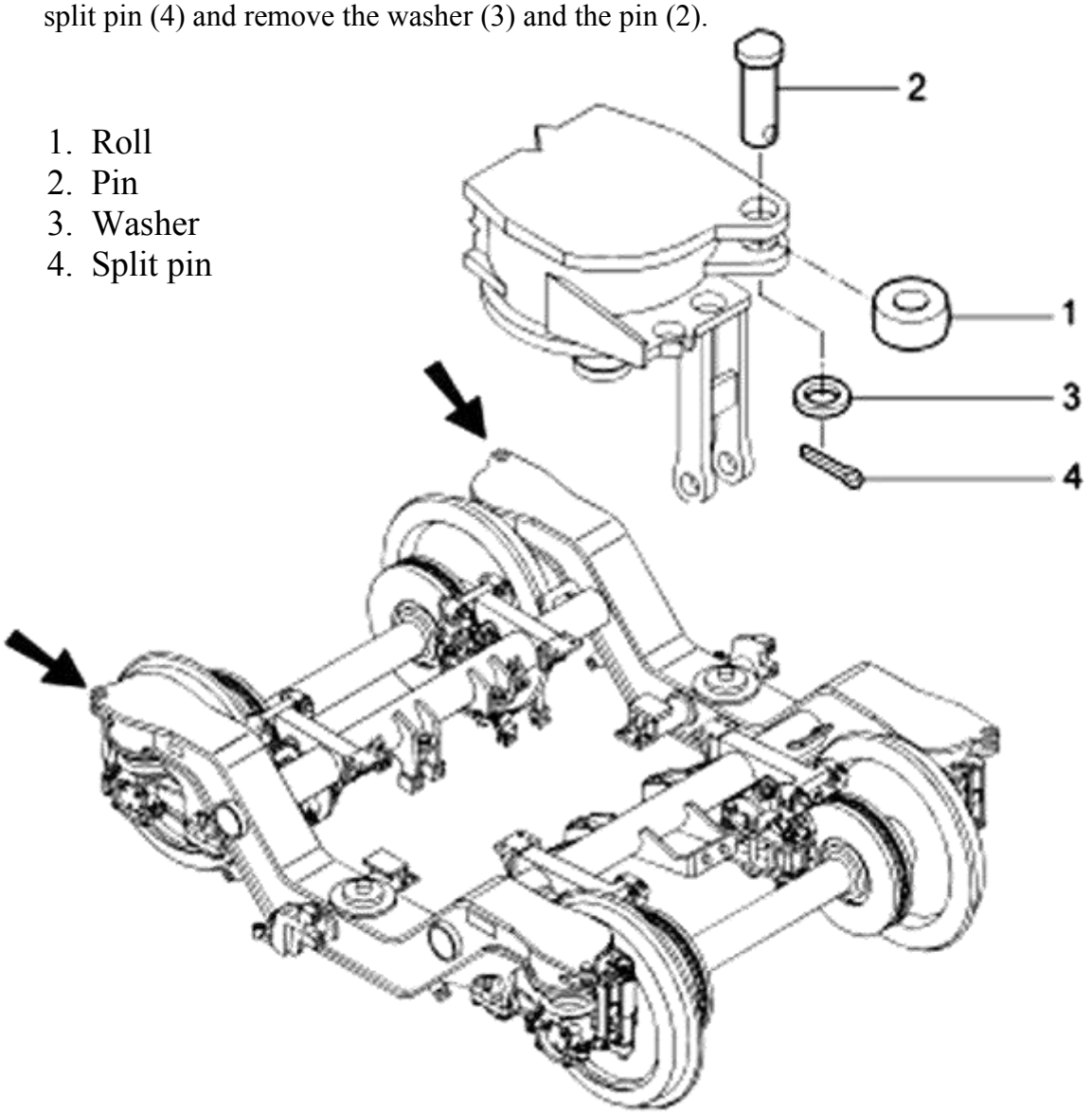


FIG. 4.32 Removal of Corner Rolls

4.3.2.5 Dismounting the Pneumatic Equipment

The pneumatic equipment (see FIG. 4.33) of the brakes can be dismounted into its simple components and completely removed from the bogie.

WARNING: BEFORE PROCEEDING BE SURE THAT NO PNEUMATIC FEED IS CONNECTED TO THE SYSTEM AND THAT NO PRESSURE IS INSIDE.

The complete equipment is made of several pipes (1) and hoses (8) connected together by various types of records (2). The pipes are kept into position on the bogie frame (3) by means of brackets (4) fixed to the frame by screws (5), washers (6) and nuts (7).

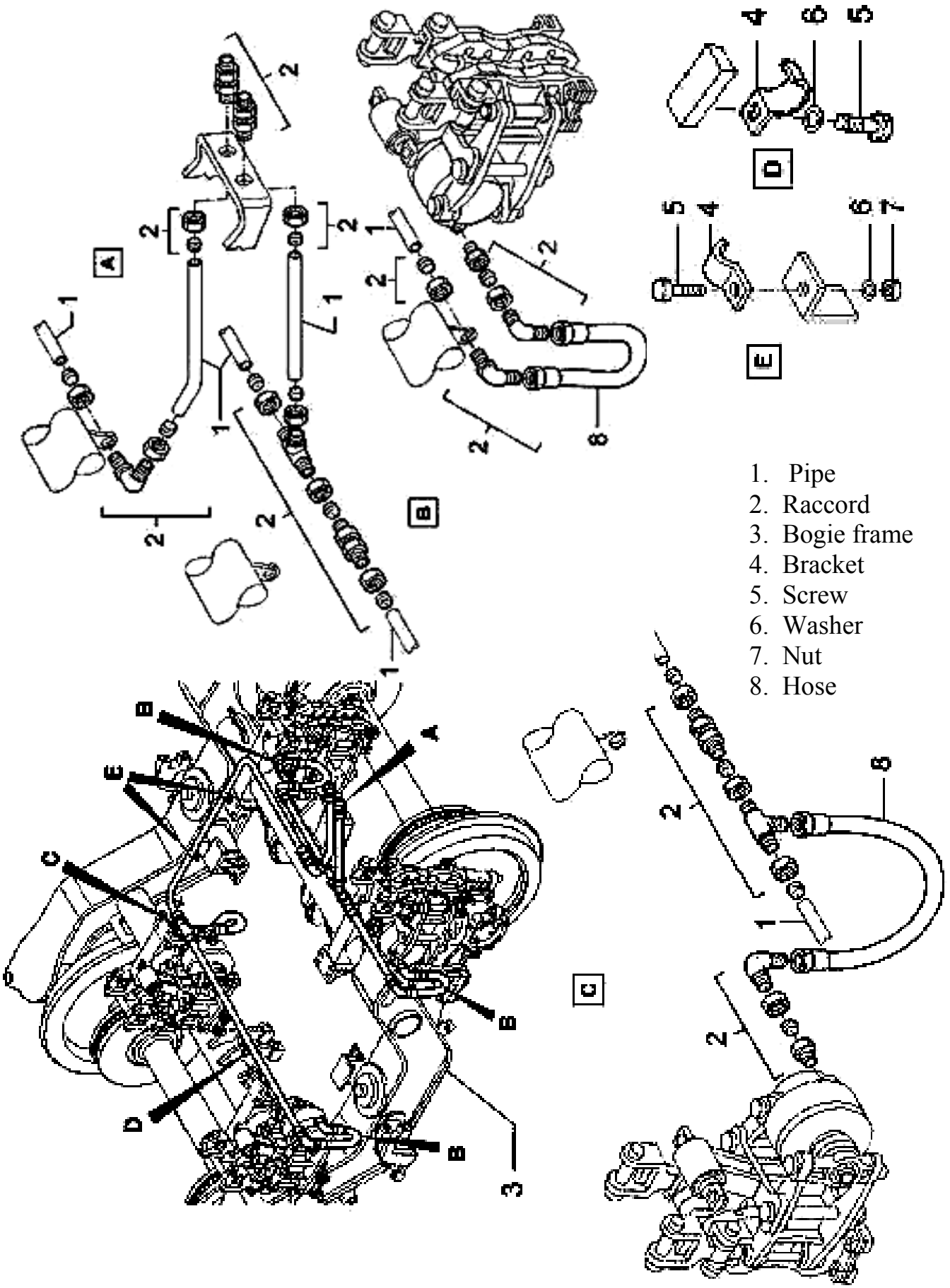


FIG. 4.33 Pneumatic Equipment Removal

4.3.2.6 Hand Brake Cables Removal (only for bogie1267334)

In order to remove the two hand brake cables (1 - FIG. 4.34 - only bogie 1267334), begin disconnecting them from the bogie frame supports (2).

Loosen the nut at the fork head (5), loosen the nut (3) and separate the cable end from the frame support.

1. Cable
2. Bogie frame support
3. Nut
4. Bellow
5. Fork head

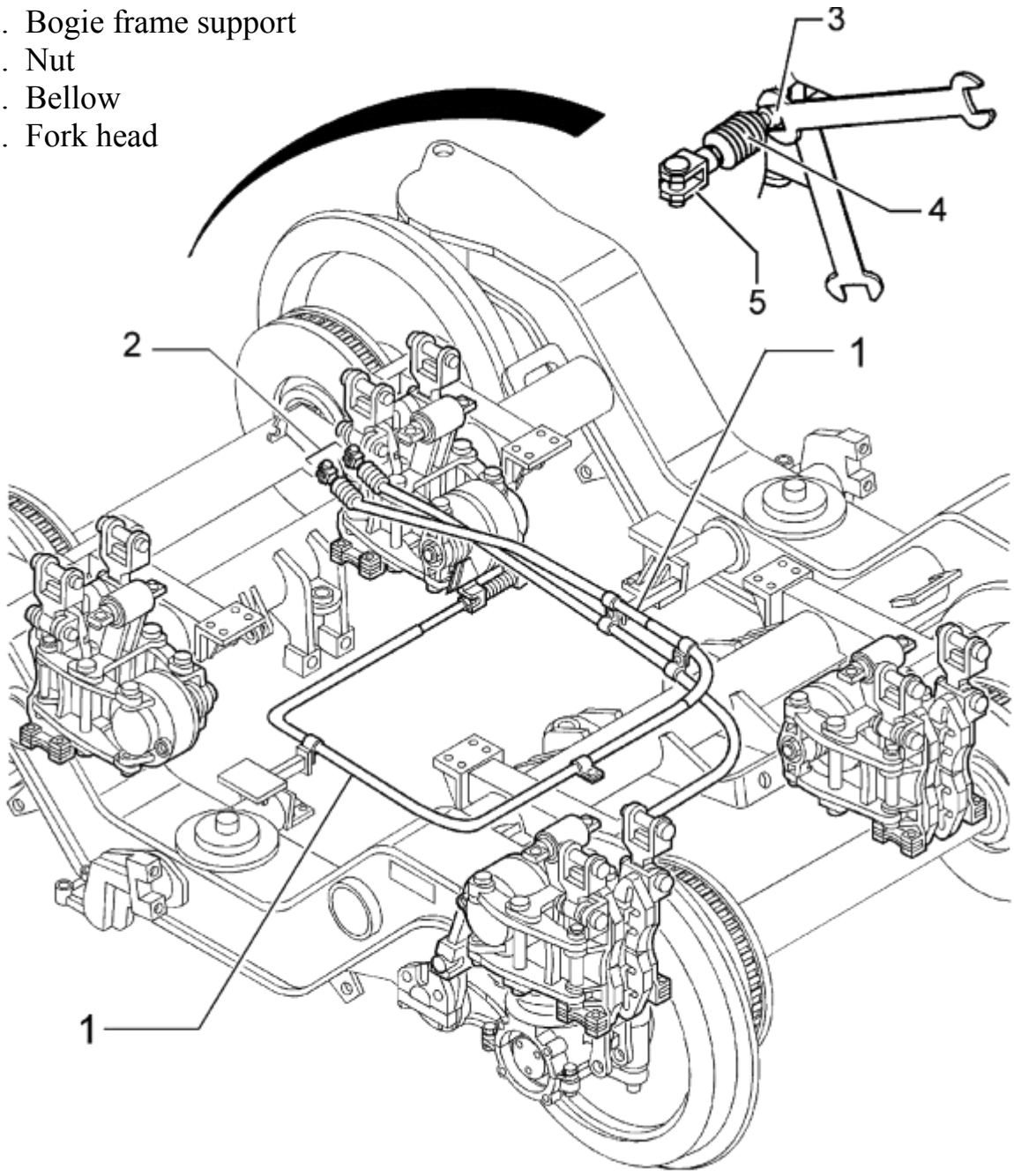
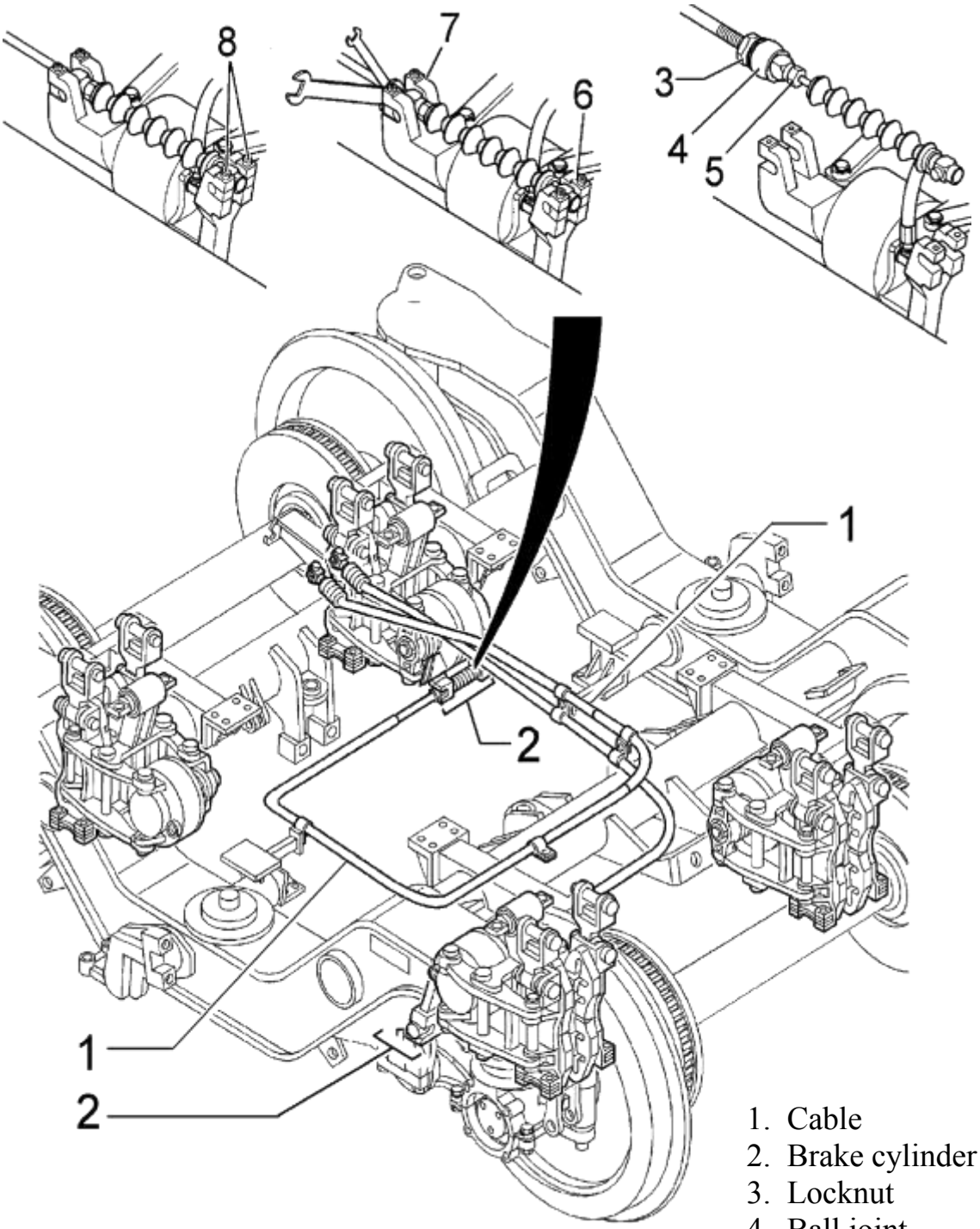


FIG. 4.34 Hand Brake Cables Removal 1/3

Then disconnect the other ends of the cables (1 - FIG. 4.35) from the brake cylinders (2): unscrew the screws (8) from both supports; rotate the locknut (3) and then the ball joint (4) until it touches the locknut (3) again. Unscrew the nut (5) and unlink the cable from both fork links (6) and (7).



1. Cable
2. Brake cylinder support
3. Locknut
4. Ball joint
5. Nut
6. Fork link
7. Fork link
8. Screw

FIG. 4.35 Hand Brake Cables Removal 2/3

Finally, remove the brackets (1 - FIG. 4-36) which link the cables together and to the frame supports (5) extracting the screws (2, 8), the washers (3) and the nuts (4).

1. Bracket
2. Screw
3. Washer
4. Nut
5. Frame support
6. Bogie frame
7. Band
8. Screw

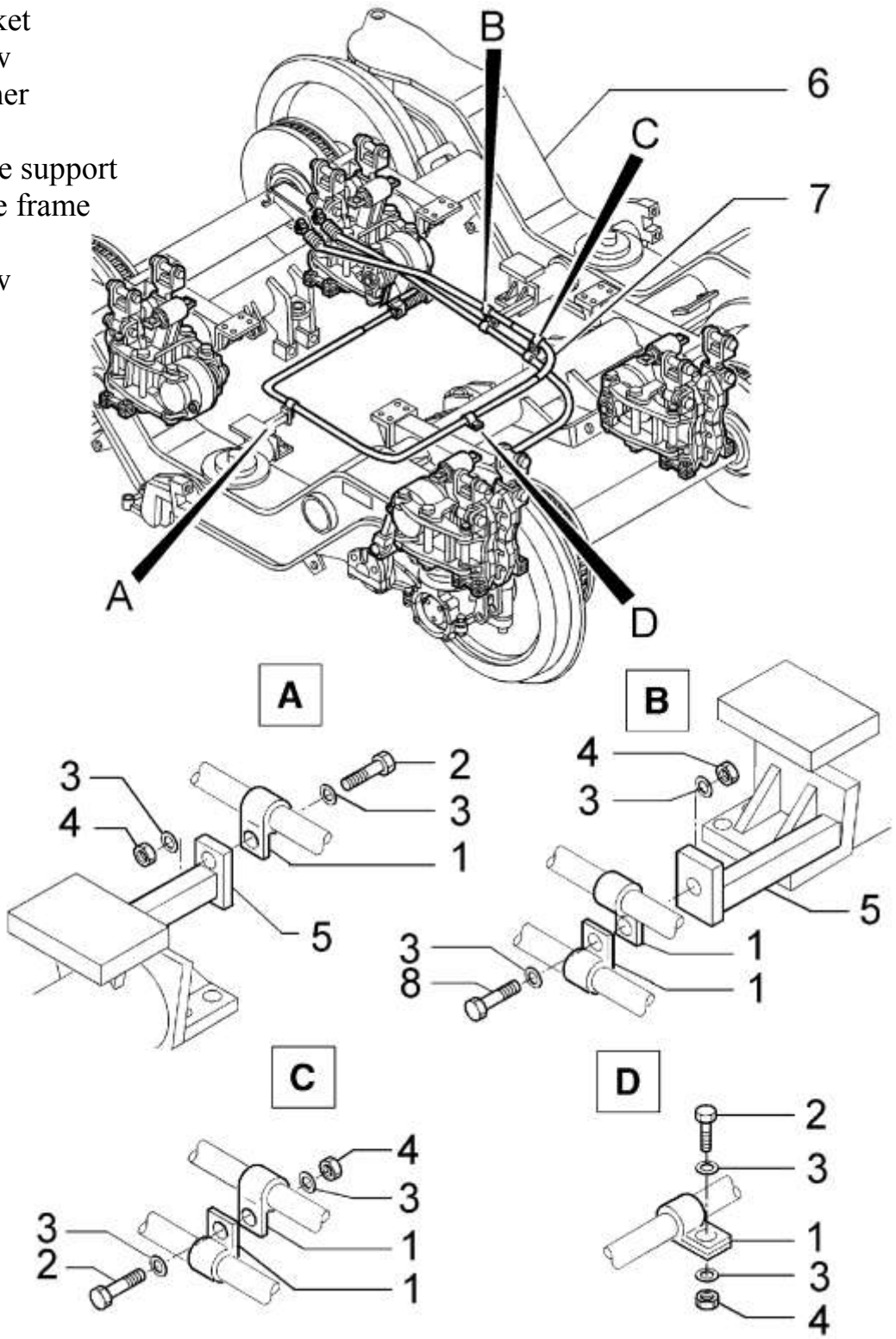
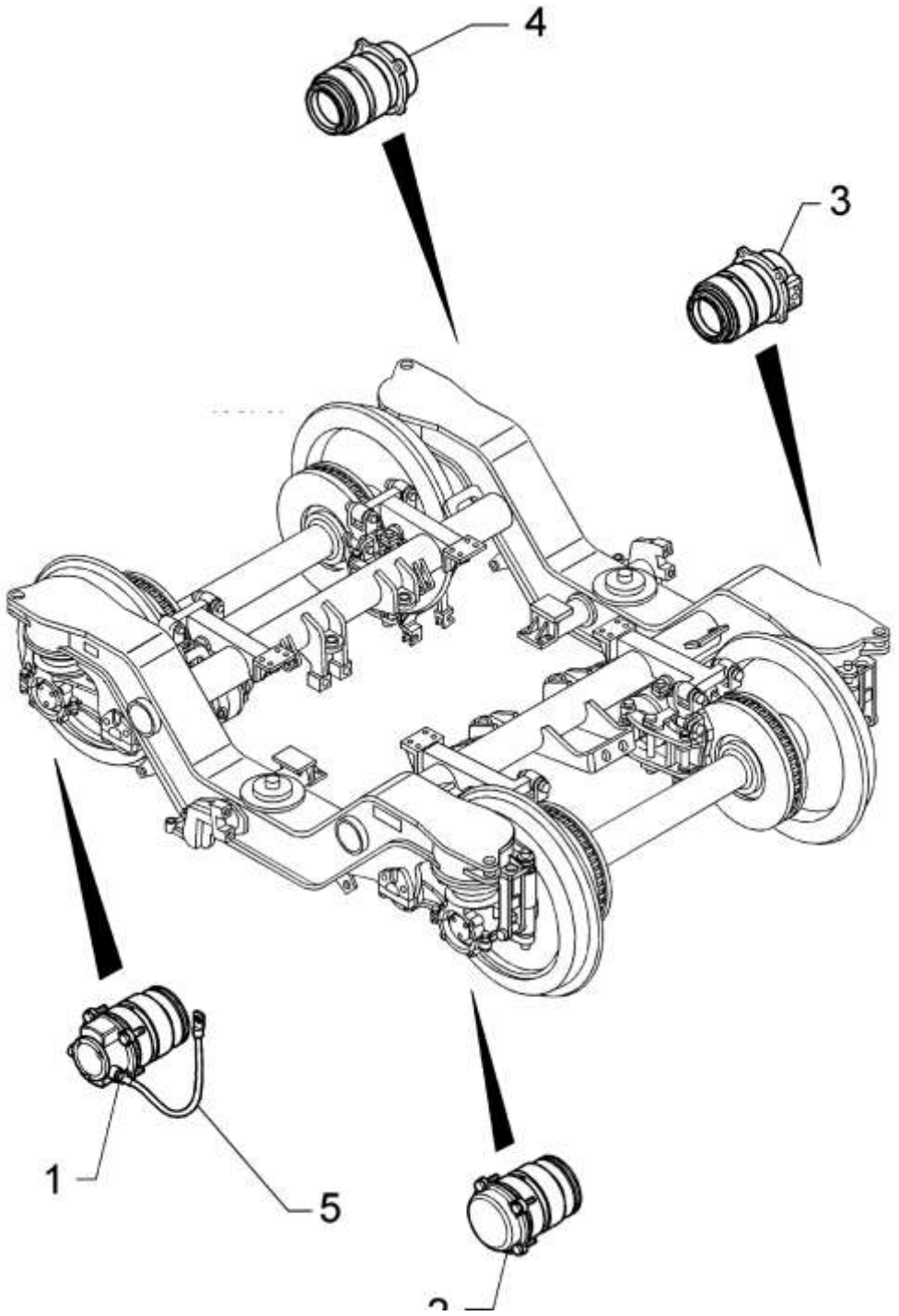


FIG. 4.36 Hand Brake Cables Removal 3/3

4.3.2.7 Removing Axle-Bearing Equipments

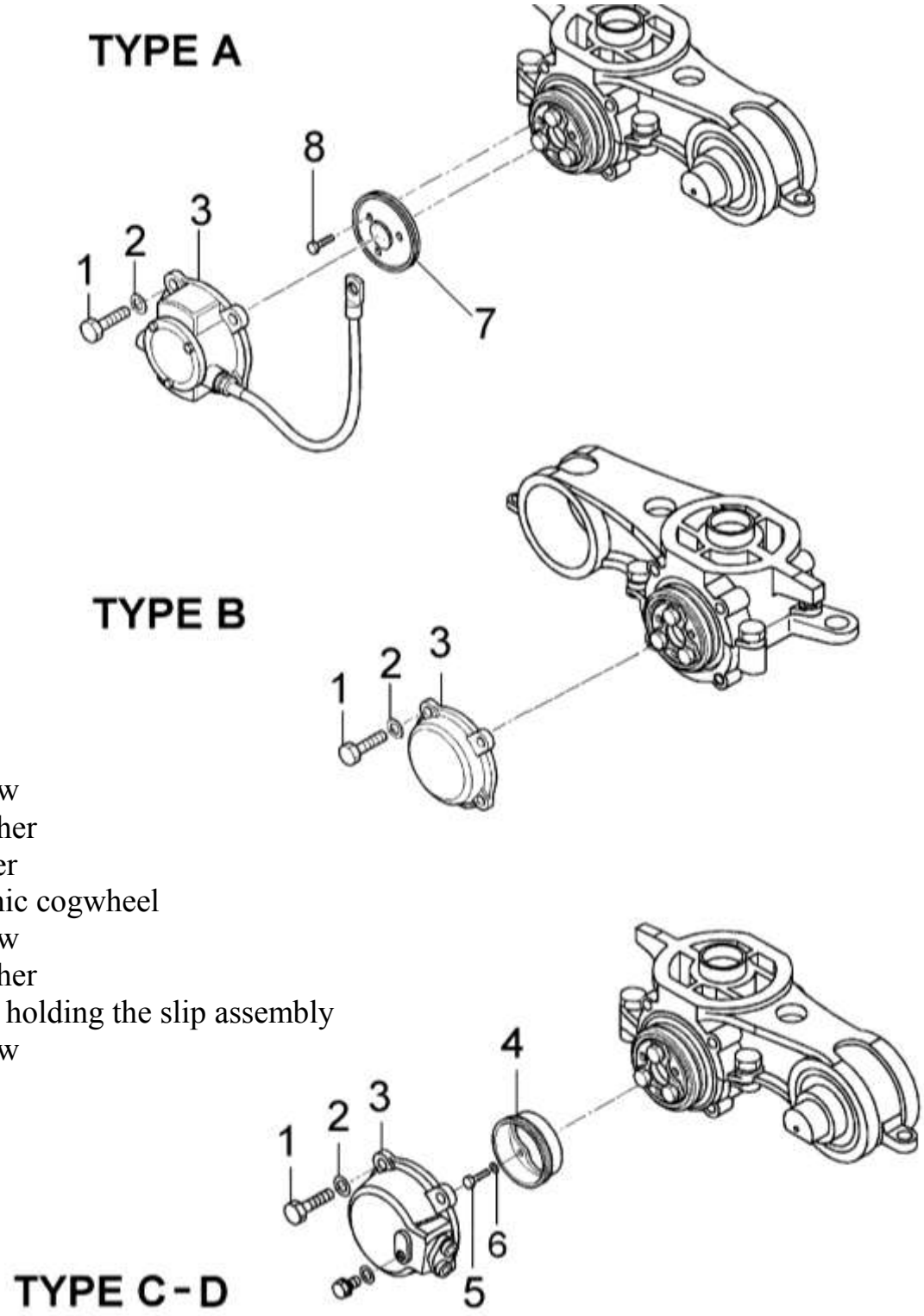
In order to remove the different equipments mounted on the axle-bearings (see FIG.4-37), first disconnect the earth cable (5) of the current return unit from the bogie frame.



1. Axle-bearing with current return device (type A)
2. Axle bearing with no sensor (type B)
3. Axle- bearing with phonic cogwheel of antiskid sensor WSP (type C)
4. Axle- bearing with phonic cogwheel of antiskid sensor WSP (type D)
5. Earth cable

FIG. 4.37 Axle- Bearings Equipment Location

Extract the screws (1 - FIG. 4-38) and the washers (2) and remove the different covers (3). Remove the phonic cogwheels (4) (Type 'C' and 'D' only) extracting the screws (5) and the washers (7). Remove the disc (7) holding the slip assembly of the current return device extracting the screws (8).

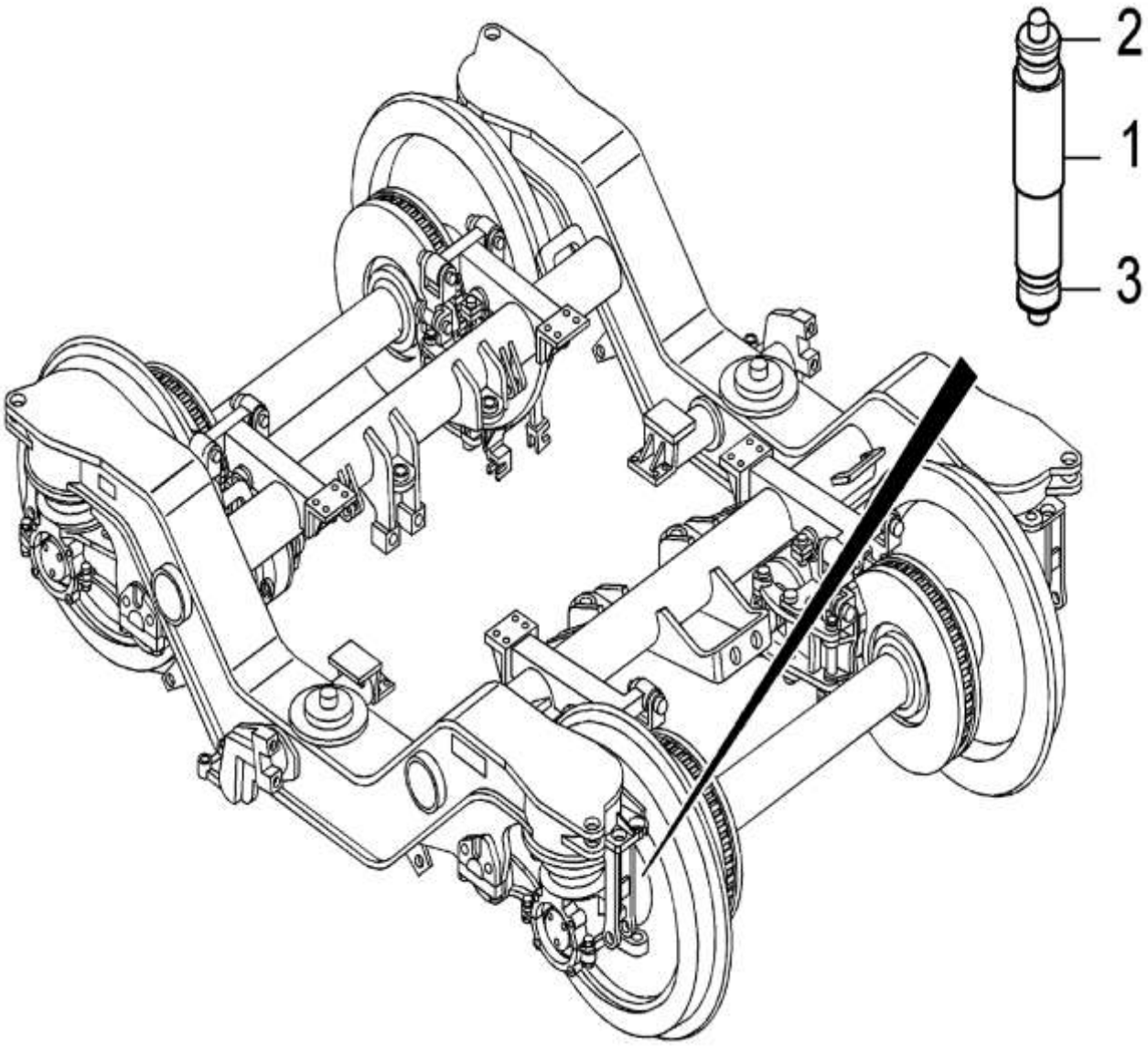


1. Screw
2. Washer
3. Cover
4. Phonic cogwheel
5. Screw
6. Washer
7. Disc holding the slip assembly
8. Screw

FIG. 4.38 Removing Axle-Bearing Equipments

4.3.2.8 Separation of the Wheel Sets from the Bogie

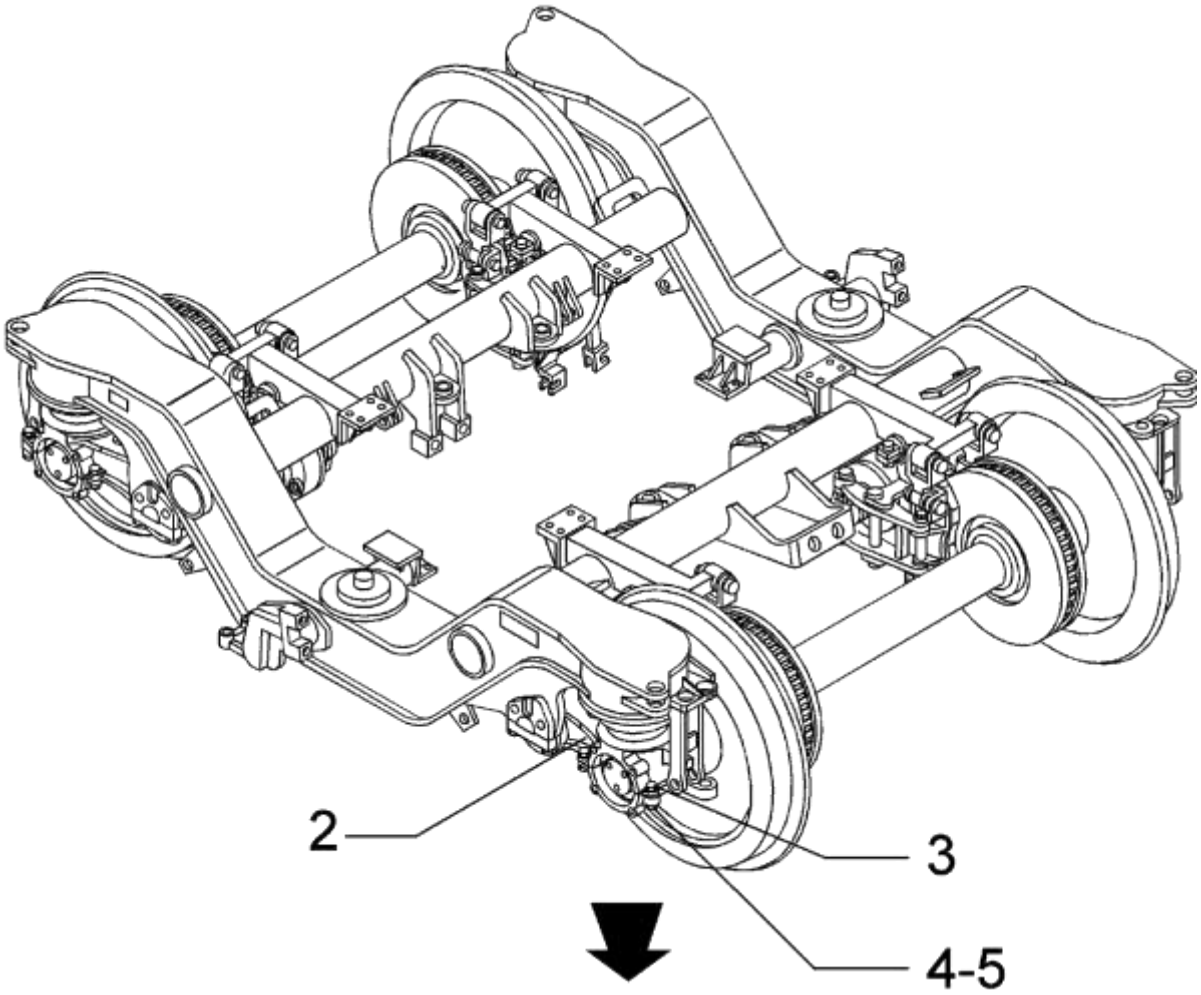
The first step for separation of the wheel sets from the bogie frame is the removal of the four vertical dampers (1 - FIG. 4-39) of the primary suspensions. In order to do so, loosen the nuts (2) and (3) at both damper ends and remove it.



1. Vertical damper
2. Nut
3. Nut

FIG. 4.39 Removal of Vertical Dampers

Then proceed with removal of the lower part (1 - FIG. 4-40) of the control arms (2), extracting the screws (3), the washers (4) and the nuts (5). proceed with all the four control arms.



1. Control arm lower part
2. Control arm
3. Screw
4. Washer
5. Nut

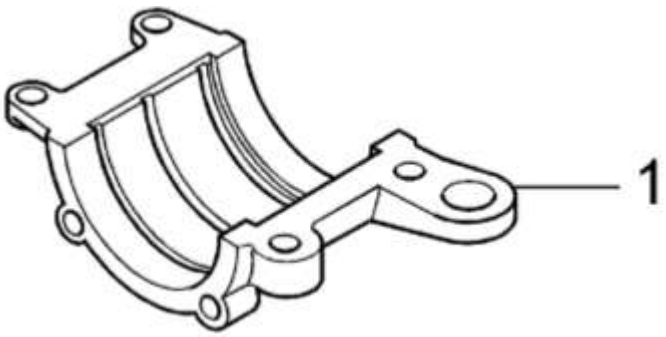


FIG. 4.40 Removal of Lower Part of Control Arms

It is then possible to proceed with lifting the bogie frame (see FIG. 4-41). Before doing so, however, make sure that both wheel sets are secured with wooden blocks (4) from both sides. Be sure that the brake levers are in OPEN position: if not, turn the nut on the brake cylinder using a wrench. Then hook the crane equipment (1) to the frame (2) and then lift it with care. The two wheel sets (3) remain on the floor and can be rolled away.

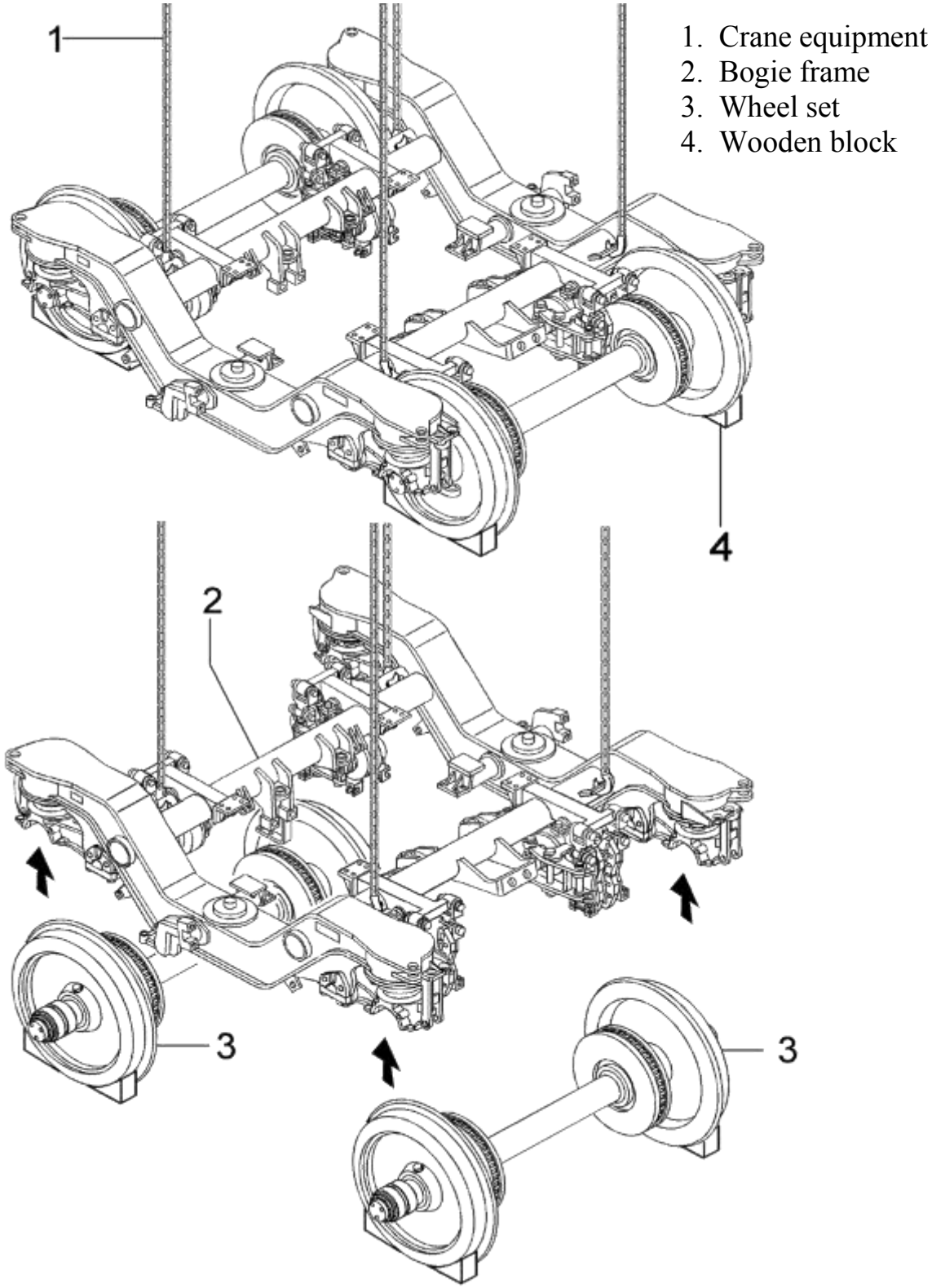
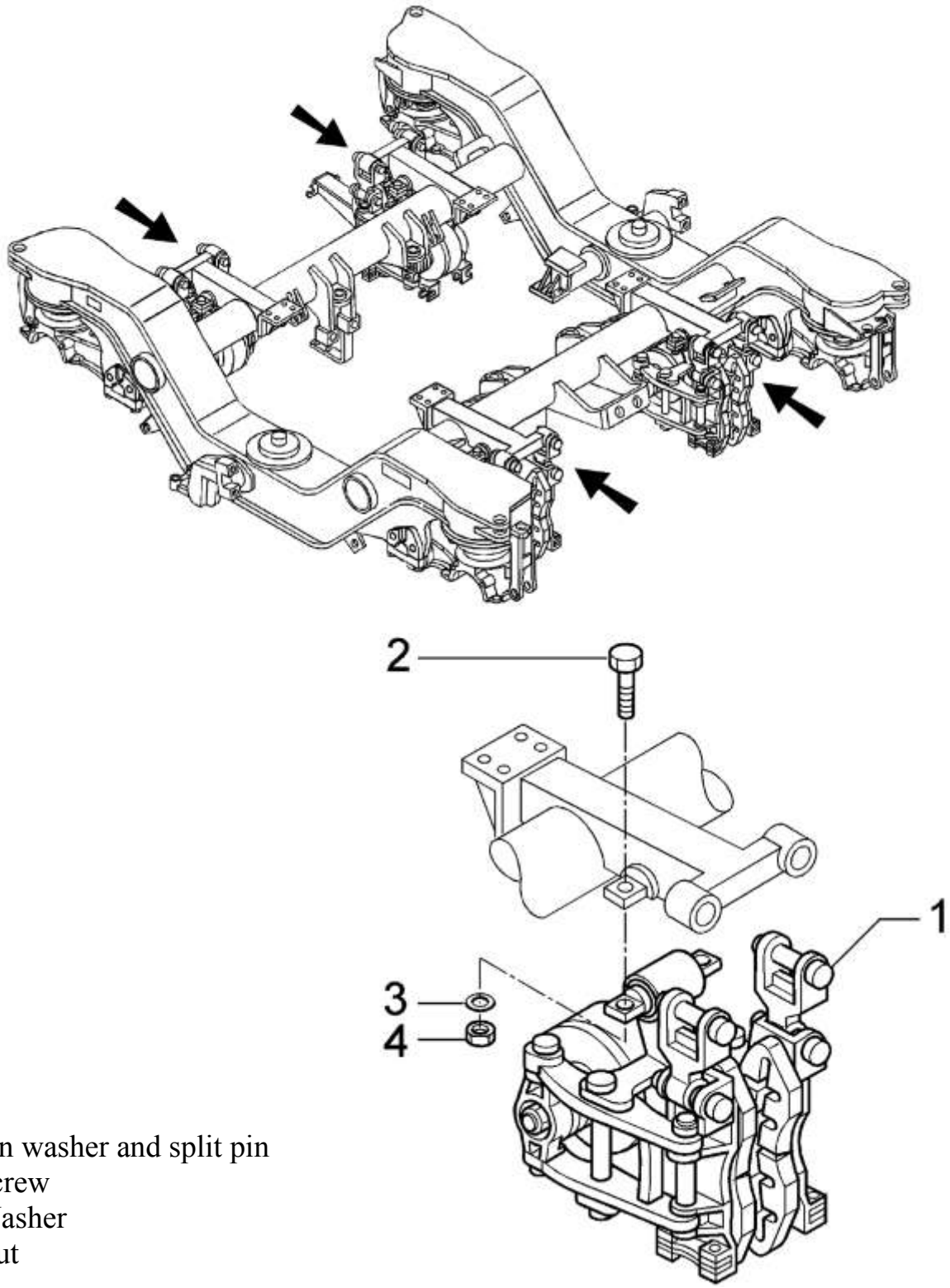


FIG. 4.41 Lifting the Bogie Frame

4.3.2.9 Removal of Brake Units

Remove the four brake units (FIG. 4-42) extracting the pin, washer and split pin (1), the screws (2), the washers (3) and the nuts (4). Pay attention not to let the units fall down.



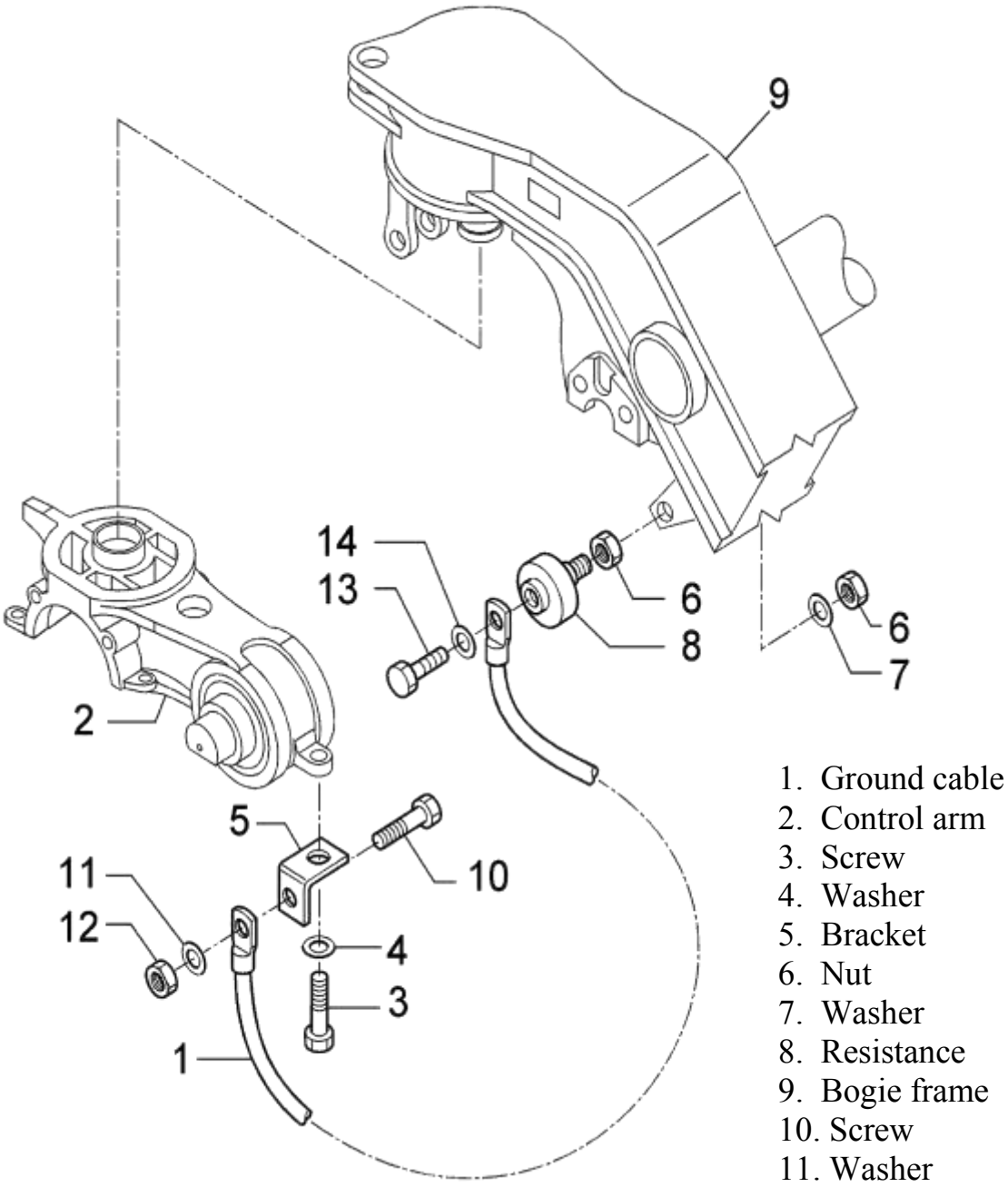
1. Pin washer and split pin
2. Screw
3. Washer
4. Nut

FIG. 4.42 Brake Groups Removal

4.3.2.10 Removing Ground Cables of the Primary Suspension

Remove the ground cables (1 - FIG. 4-43) from the primary suspension (2) extracting the screw (3) and washer (4) which fix the bracket (5) to the control arm and the nuts (6) and washer (7) which fix the resistance (8) to the bogie frame (9).

It is then possible to completely separate the bracket (5) from the cable (1) exctracting the screw (10) with the washer (11) and the nut (12), and also the resistance (8) extracting the screw (13) and the washer (14).



1. Ground cable
2. Control arm
3. Screw
4. Washer
5. Bracket
6. Nut
7. Washer
8. Resistance
9. Bogie frame
10. Screw
11. Washer
12. Nut
13. Screw
14. Washer

FIG. 4.43 Removing the Ground Cables

4.3.2.11 Bogie Rotation from Normal Position to Reversed

In order to accomplish the removal of the primary suspension, it is necessary to rotate the bogie from the normal position to the reversed one (see FIG. 4-44). This operation is necessary in order to operate the dismounting under safe working conditions.

A- Tie a suitable lifting strip (3) on one side of the bogie frame (1) rested on supports (2)

B- Prepare supports (4) under the frame aside to supports (2). Lift the frame on one side.

C- Complete rotation of the frame and let it rest in reversed position on supports (4)

WARNING: *PAY ATTENTION WHEN LIFTING THE BOGIE FRAME. UNNECESSARY PEOPLE MUST STAY OUT OF THE LIFTING AREA*

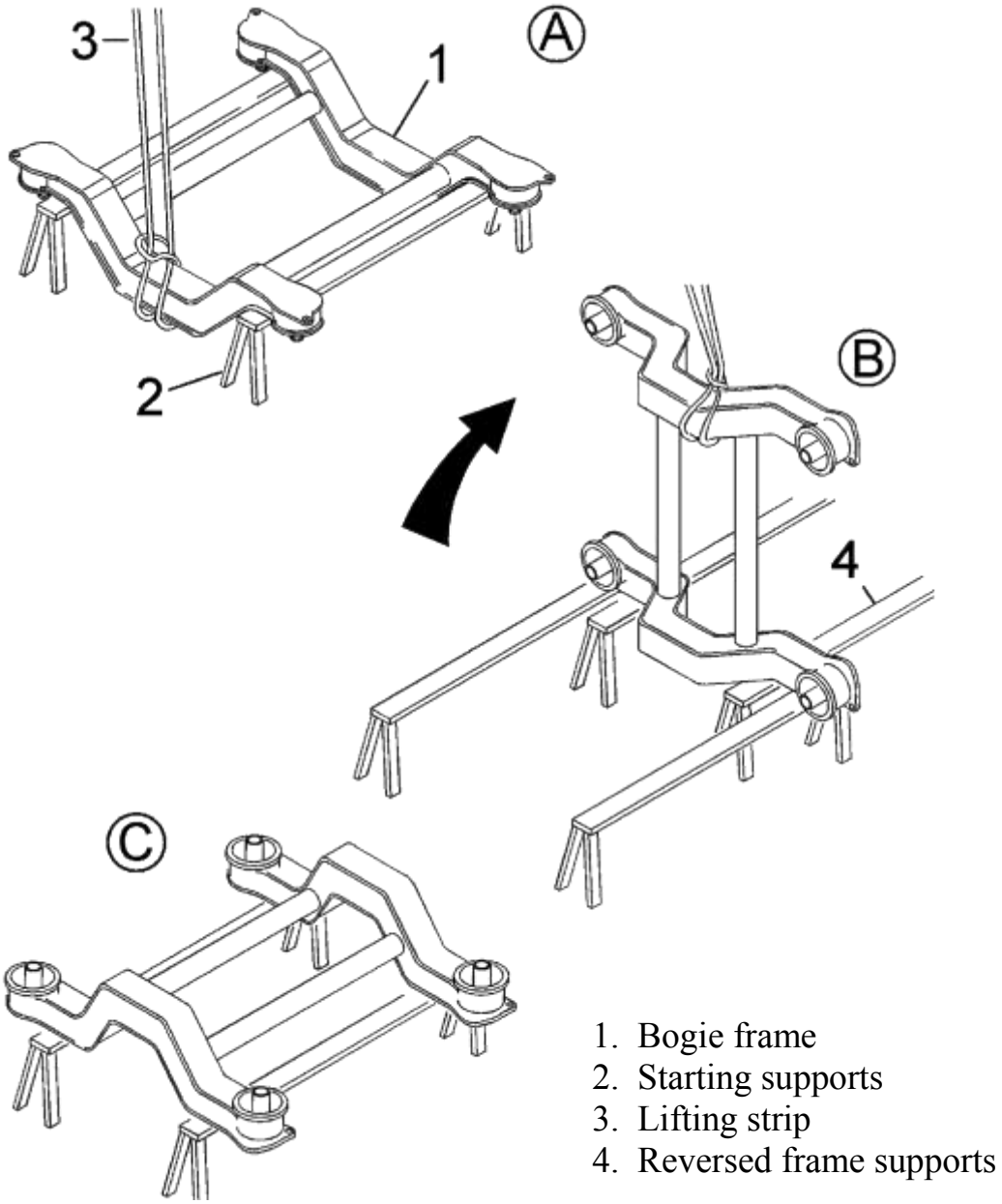
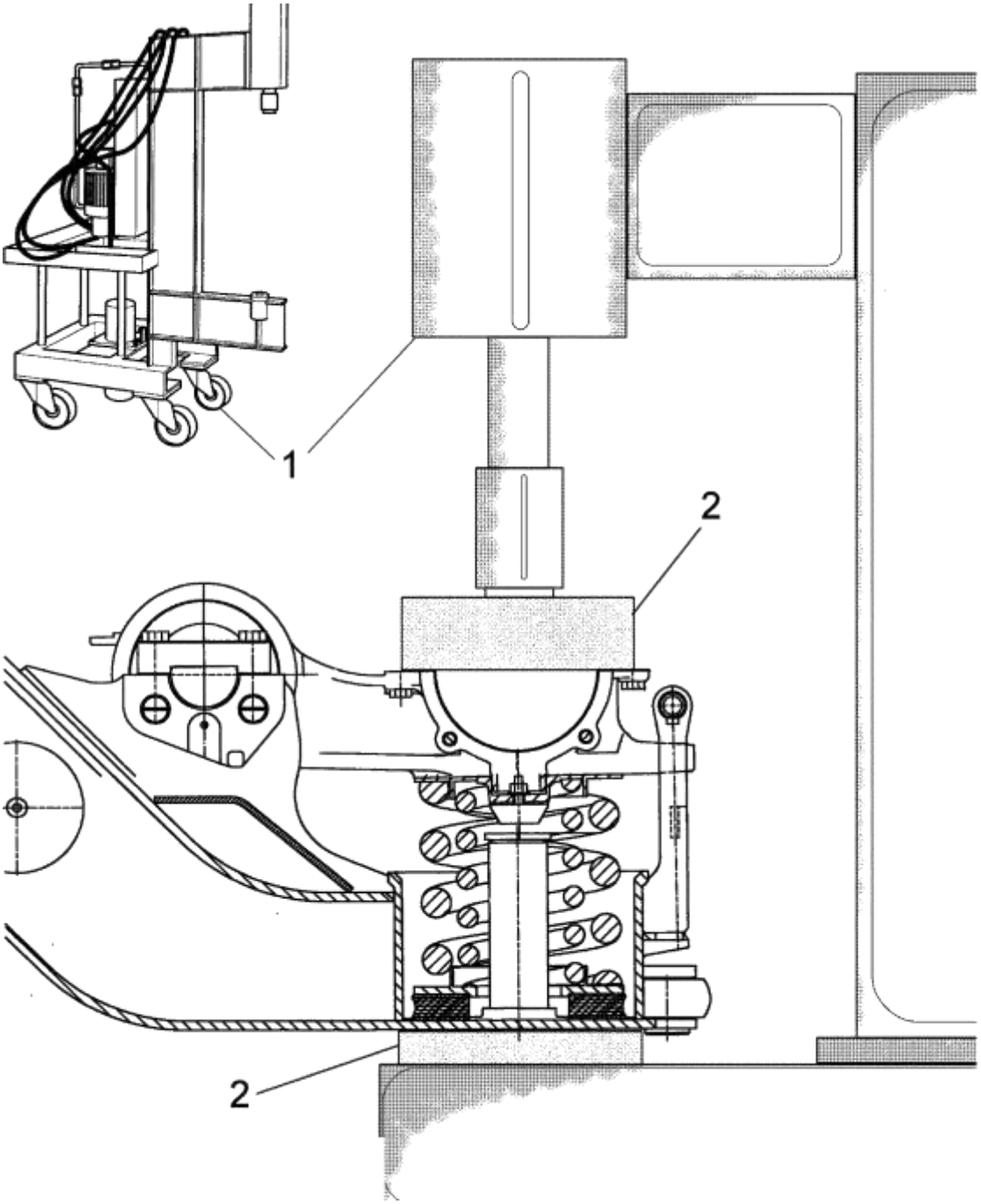


FIG. 4.44 Bogie Rotation

4.3.2.12 Dismounting the Primary Suspension

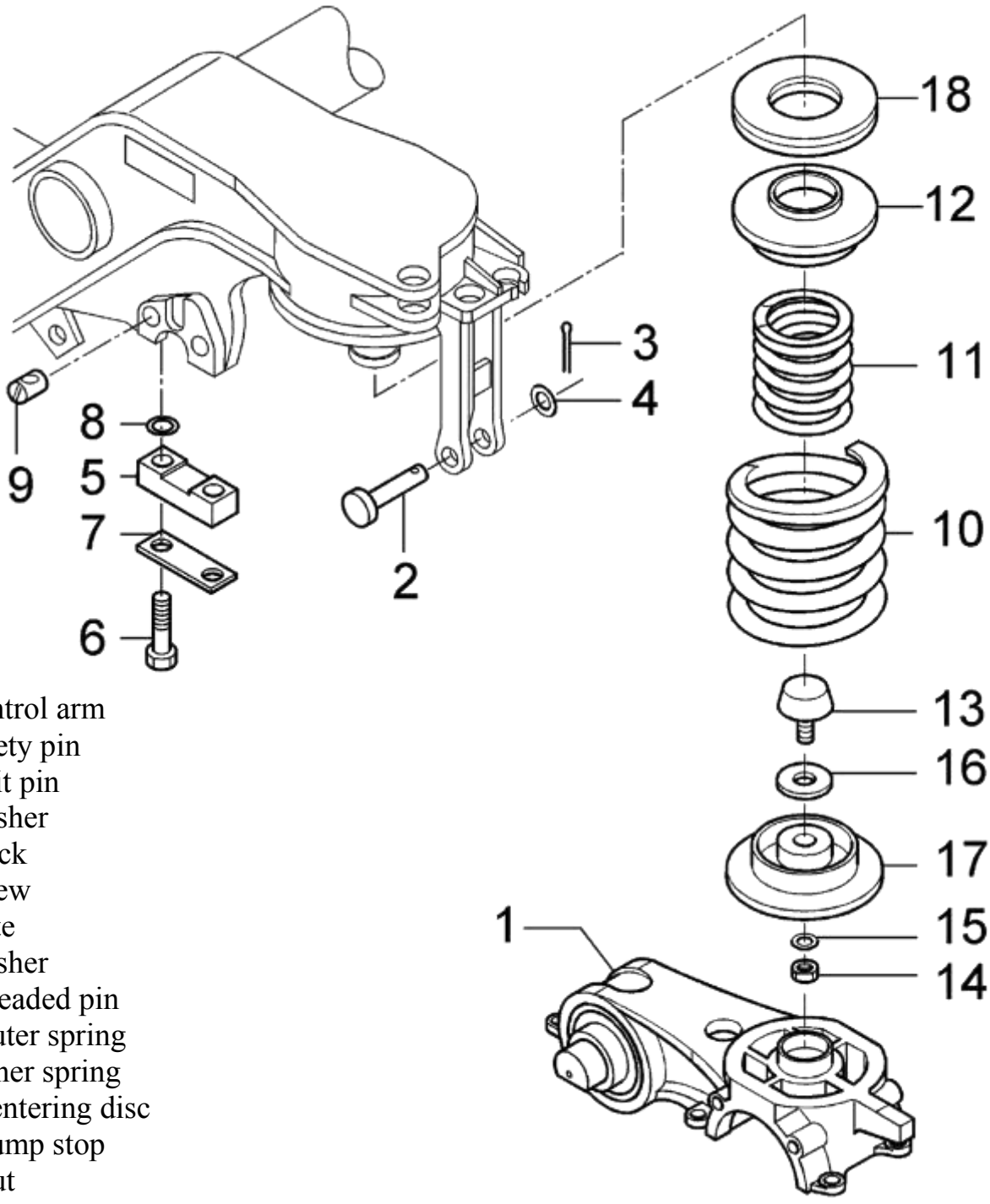
In order to dismount the primary suspension it is necessary to put it under press (1, Fig. 4-45). Before pressing put wooden blocks (2) between the press (1) and the bogie, to avoid damaging the control arm and the frame.



1. Vertical press **12.613.0404**
2. Wooden block

FIG. 4.45 Primary Suspension Under Press

After pressing the spring pack, remove the safety pin (2, FIG. 4-46) extracting the split pin (3) and the washer (4). Separate the control arm (1) from the bogie removing the fixing blocks (5), the plates (7), the washers (8) and the threaded pins (9) by unscrewing the screws (6). Release carefully the pressure until it is possible to remove the external (10) and internal (11) springs, and the upper centring discs (12). Remove the lower centring disc (17), and then unscrew the bump stop (13) removing the nut (14), the washer (15) and the disc (16).



1. Control arm
2. Safety pin
3. Split pin
4. Washer
5. Block
6. Screw
7. Plate
8. Washer
9. Threaded pin
10. Outer spring
11. Inner spring
12. Centering disc
13. Bump stop
14. Nut
15. Washer
16. Disc
17. Centering disc
18. Rubber pad

FIG. 3.46 Dismounting the Primary Suspension

4.3.2.12.1 WEAR LIMIT ON CONTROL ARM OF LHB TYPE COACHES:

Action: To standardize the inspection criteria and set rejection /allowed dimensions for the inspection of the Control Arm bracket.

Reason: Most of the Control Arm is found worn out in service, as per the standard dimensions mentioned in drawing.

The system shall be followed for inspection as under:

1) During IOH / POH control Arm should be examined for excessive wear, irregular wear and corrosion.

2) After removal of corrosion, the bearing surface should be examined. If the control arm bearing surface reach a diameter of 230.5 mm (i.e. wear out by more than 0.5mm), whether locally or on the complete surface, the control arm should be considered worn out and rejected.

3) In case the diameter is between 230.5 and 230.312, the control arm may be re-machined by providing a cut of 0.3 – 0.5 mm on the face of control arm. This machining operation should not be carried more than once.

4) In case the diameter is less than 230.312 mm, the control arm may be re-used without re-machining.

5) These limits shall be reviewed after gaining sufficient experienced during next 2-3 years.

The control arm should be coated with " BLASOL 135 " solution (Equivalent to Cortec VCI-368 & Molytec EP) during POH/IOH, whether new or reused control arm is used, to prevent wear and corrosion. Drying to touch time is given as 0.5 to 3 hours.

4.3.3 Dismounting other Assemblies

4.3.3.1 Removing the Axle-Bearings from the Wheel Set

The first operation to perform is the removal of the safety discs (1 - FIG. 4-47) from all the bearings. Unscrew and extract the screws (3) which fix the safety plate (2). Remove the safety plate (2) and finally the disc (1).

After this operation, it is possible to remove the bearings.

1. Safety disc
2. Safety plate
3. Screw

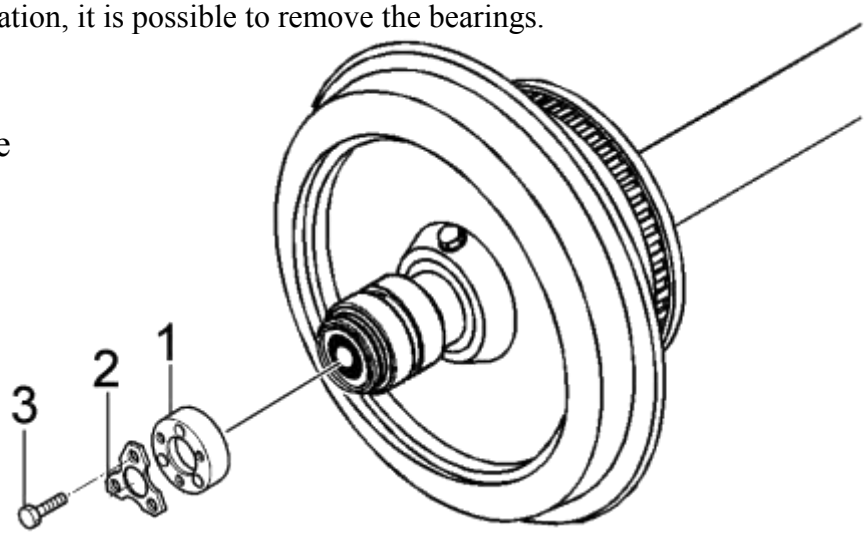
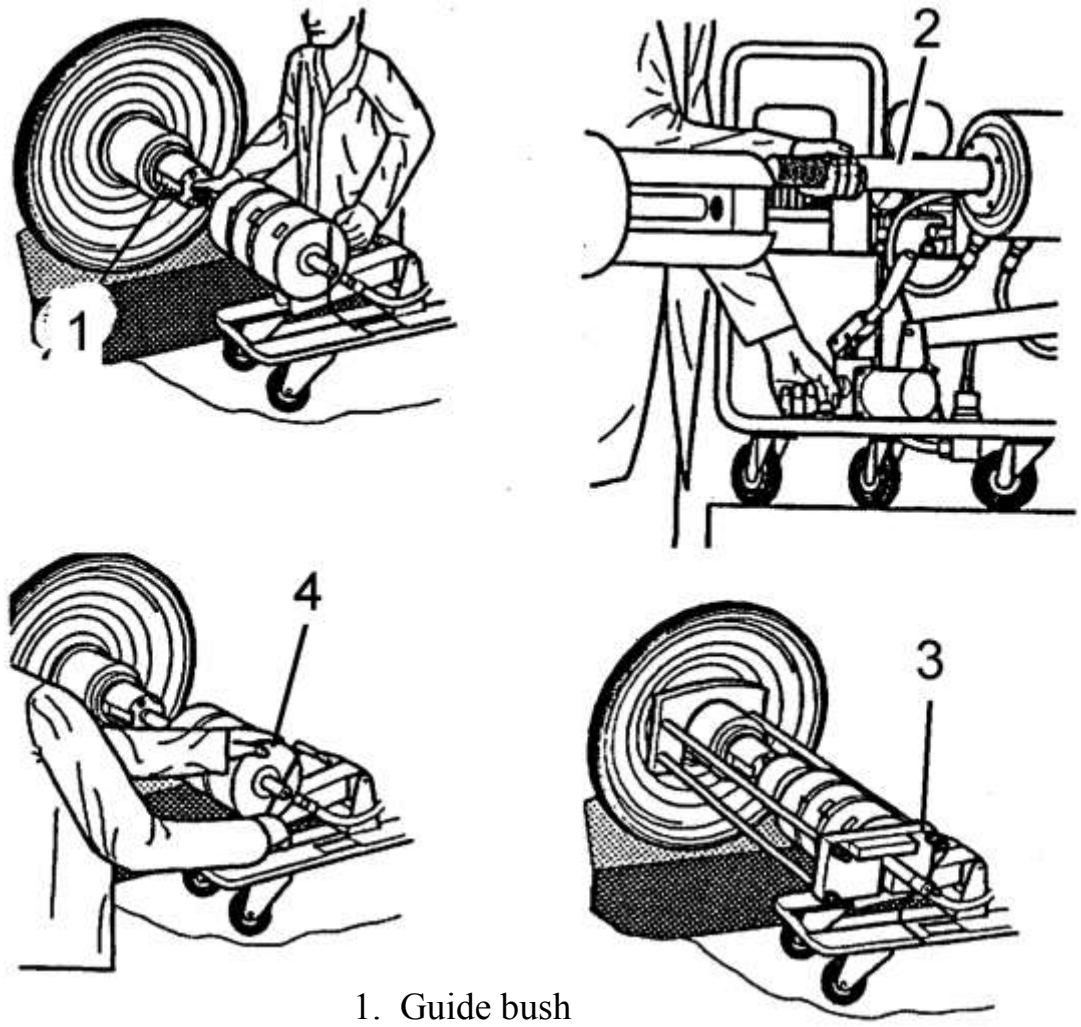


FIG. 3.47 Remove the Discs Fixing The Bearings

In order to remove an axle bearing from the wheel set it is necessary to use the following tools:

- Guide bush tool nr. 12.695.0176
- Press tool nr. 12.613.0399
- Lock rod with profiled element tool nr. 12.695.0401

Screw the guide bush (1 - FIG. 4-48), insert the shaft without the lock nut by the press piston (2). Move upward and position the press (3). Insert the shaft into the guide bush (1). Lay the lock rod with the coupling element (4), start the pump motor, operate the control lever and move the bearing by pressure.



1. Guide bush
2. Press piston
3. Press
4. Coupling element

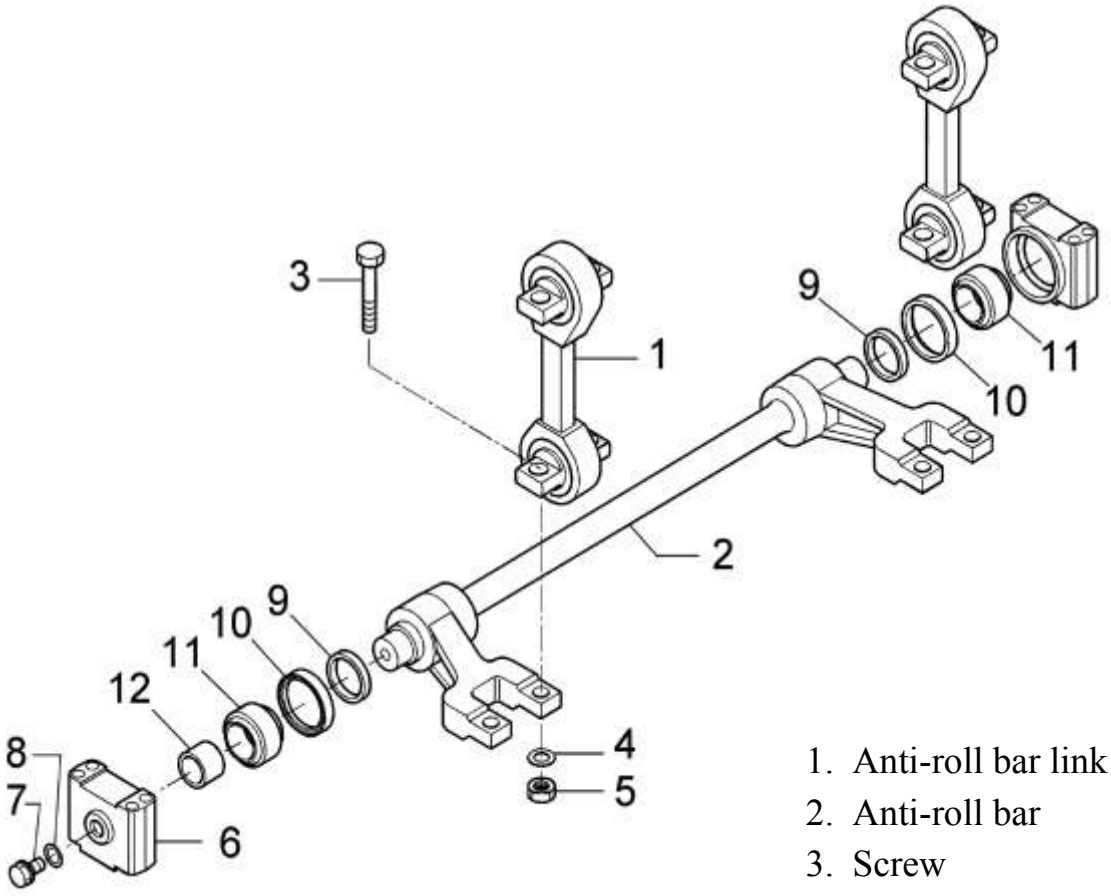
FIG. 3.48 Axle Bearing Removal

4.3.3.2 Dismounting the Anti-Roll Bar

Separate the anti-roll bar links (1- FIG. 4-49) from the anti-roll bar (2) extracting the screws (3), the washers (4) and the nuts (5).

Then separate the brackets (6) extracting the screw (7) and the washer (8).

Remove the sealing ring (9), the spacer (10), the bearing (11) and the bush (12).



1. Anti-roll bar link
2. Anti-roll bar
3. Screw
4. Washer
5. Nut
6. Bracket
7. Screw
8. Washer
9. Distance holder
10. Sealing ring
11. Bearing
12. Bush

FIG. 3.49 Dismounting the Anti-Roll Bar

4.3.3.3 Extraction of the Rubber Joints

The rubber joints (1 - FIG. 4-50) from the anti-roll bar links (2), from the control arm (3), from the traction rods (5) can be extracted using a press (4). At the same way it is possible to extract the bush (6) from the traction lever (7).

Use below listed special tools for removal of different components:

- Control arm joint removal tool 12.613.0402
- Anti-roll bar joint removal tool 12.695.0177
- Traction centre bush removal tool 12.695.0178

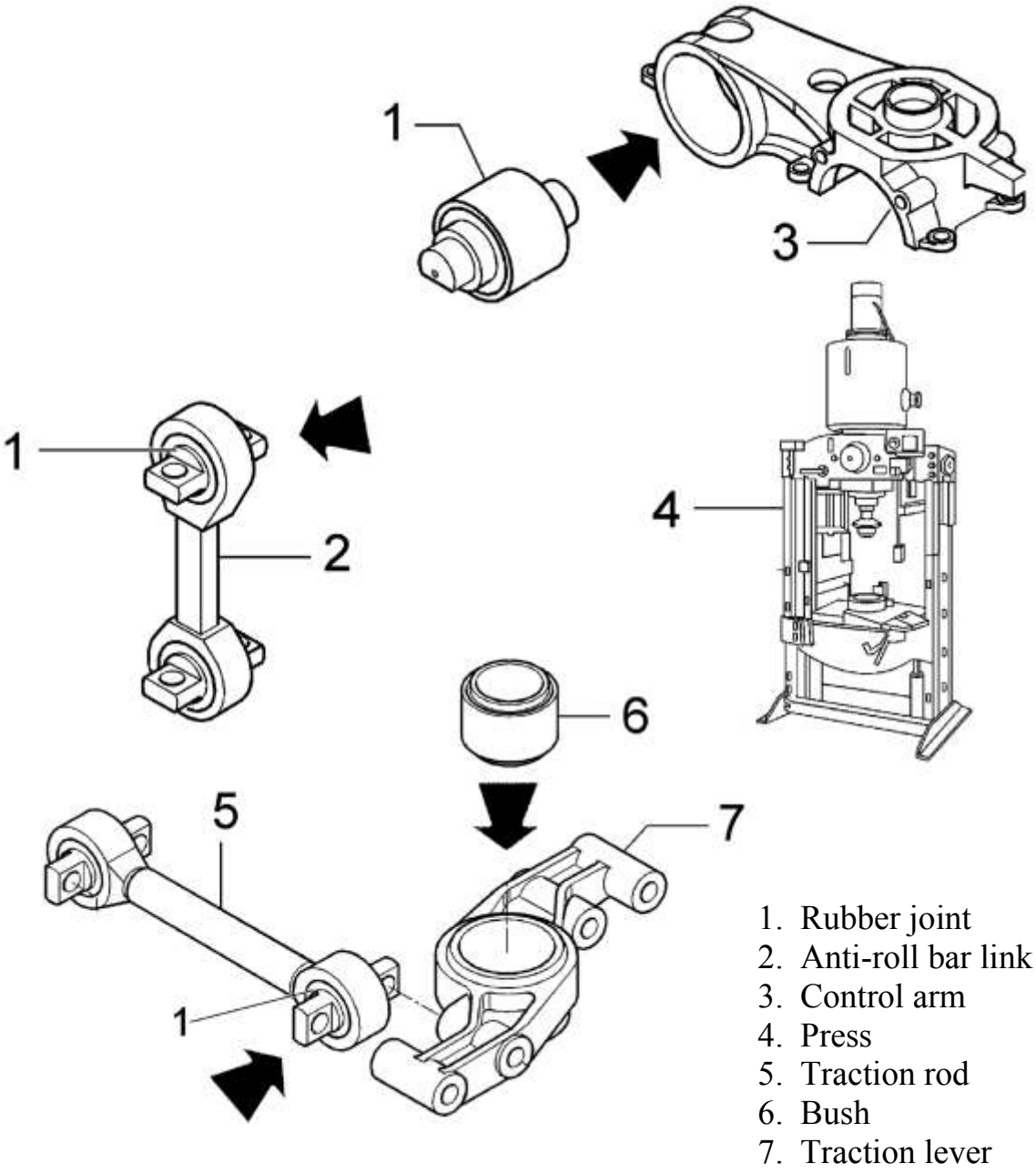


FIG. 3.50 Extraction of the Rubber Joints

4.4 WHEEL AND AXLE ASSEMBLY

4.4.1 Maintenance Procedure in the Workshop

i) Pre-inspection of wheels in the workshop

During pre-inspection of incoming wheels, the wheel-set is inspected for assessing the condition of the components. Following measurements are carried out on all the wheels, received in shop for repairs.

a) Measurement of a wheel gauge (distance between two wheels flanges on the same axle)

The distance between two wheel flanges on the same axle should be **1600 mm+ 2/-1 mm**. This measurement should be taken at three locations apart with the help of an adjustable pi gauge. If wheel gauge is not within permissible limits, then the wheel disc (s) have to be pressed off and then pressed on.

b) Measurement of Wheel Diameter (Tread Diameter)

The wheel diameter is measured with the help of a trammel gauge with a least count of **0.5 mm**. on both sides. However, a gauge with a least count of **0.1 mm**. is recommended as the measurement of a diameter would be more accurate with this gauge.

The difference in tread diameter of the two wheels on the same axle should not exceed **0.5 mm** after tyre turning. There is no 'In service' limit for this variation and rejection shall be decided by tyre defect gauge

During last shop issue the wheel is to be turned to RDSO SK-91146. The profile is to be turned **1 mm** above the condemning limit groove.

c) Inspection of wheel disc as per CMI-K003

The wheel should be inspected for rejectable defects in accordance with RDSO‟s instructions CMI-K003

d) Inspection of Wheel Flanges

The flanges on both sides of a wheel set are checked with the help of a profile gauge to measure the height and thickness of flanges. Accurate measurement of flange height and flange thickness is not possible with the profile gauge. It is, therefore, recommended to use a wheel profile gauge with which accurate measurement of flange height and flange thickness to the extent of **0.1 mm** can be made.

After recording the diameters of wheels and wheel flange measurements, the wheel set is nominated for necessary repairs.

e) Inspection of axle

Axle journals should be thoroughly cleaned for inspection to detect flaws, pitting, ovality, taper, ridges etc. Each axle should be ultrasonically tested for detecting internal flaws and defects as per the code of procedure issued by RDSO. Axles found flawed, pitted or with under size journals should be replaced.

4.4.2 Examination And Repair Practice In Carriage Maintenance Depot

Depot maintenance staff should ensure the following things in respect of proper functioning and safety of rolling gear:

a) Wheel and axle

Wheel profile should be checked with Tyre defect gauge to ensure the profile dimensions are within the permissible limits. Coaches with wheels having thickness and profile worn below condemning limit should not be allowed to continue in service and the coach should be marked sick for change of wheels in the sick lines.

i) Limits for flat tyres

The limits for permissible maximum flat surfaces on tread for BG ICF coaches is **50 mm** (reference Rly. Bd.'s Letter no. 83/M (N)/960/1/Vol I dated 15/18.3.99)

ii) Guidelines for wheel inspection in open line depots (Ref RDSO CMI-K003)

In addition to normal checks exercised on wheel condition during primary/secondary maintenance of coaches, a detailed inspection of wheels should be done when the coaches are received in sickline for attention for either schedules or out of course attention. The wheels sets shall be inspected for the following conditions and action taken as indicated for each condition:

1. **Shattered Rim –** a wheel with a fracture on the tread or flange must be withdrawn from service. This does not include wheels with localized pitting or flaking without presence of any rejectable condition.

2. **Spread Rim-** If the rim widens out for a short distance on the front face, an internal defect may be present. Spreading of the rim is usually accompanied by a flattening of the tread, which may or may not have cracks or shelling on the tread. Such wheels must be withdrawn from service.

This condition should not be confused with a uniform curling over of the outer edge of the rim around the entire wheel, which is called rim flow. Rim flow is not a defect.

3. **Shelled Tread -** Shelling can be identified by pieces of metal breaking out of the tread surface in several places more or less continuously around the rim. Shelling takes place when small pieces of metal break

out between the fine thermal checks. These are generally associated with small skid marks or "chain sliding.". Such wheels should be withdrawn from service and sent to workshops for reprofiling.

Railways are facing the problem of wheel shelling on LHB coaches. A shelled wheel requires re-profiling to ensure that unsafe situations do not arise. For this purpose, following shelling limits need to be followed.

1. Depth of shelling marks has reached to 1.5 mm.
2. Length of shelling marks has reached to 40 mm.
3. Depth of hollow tyre reached to 3 mm. This limit of 3 mm is kept to study the effect of wheel shelling and service life of wheels. The rejectable limit of hollow tyre will continue as more than 5 mm as specified in IRCA part IV.

The turning of LHB wheels as per the above guidelines will increase the frequency of wheel turning but loss of diameter in turning will be less. So over all wheel life will increase. It is seen during the study that the average diameter reduction during the tyre turning at present is 11mm where as per new guidelines; diameter reduction is expected to be 6-7 mm only.

Railways should maintain the kilometer earning and diameter reduction during turning as per the above yard sticks to assess the enhanced wheel life Railways are requested to immediately implement the above instructions.

4. **Thermal Cracks –** Thermal cracks appear on a wheel tread due to intense heating of the wheel arising out of severe brake binding. Such cracks occur on the tread and generally progress across the tread in a transverse & radial direction. Whenever such a crack becomes visible on the outer face of the rim or tread crack has reached the outer edge (non-gauge face) of the rim, the wheel should be withdrawn from service. If a crack becomes visible on the outer flange face, the wheel should be withdrawn from service. Such wheels should be sent to workshop for examination and subsequent rejection.

Wheels involved in service brake binding should be examined carefully during the maintenance to rule out the possibility of rejectable thermal cracks. Such wheels may be identified by presence of flats (even within acceptable limits) and severe discoloration or blue black heating marks on the tread.

5. **Heat checks** – Thermal cracks are deeper and need to be distinguished from fine superficial cracks visible on the tread on or adjacent to the braking surface. These are called heat checks, which are usually denser than the thermal cracks. Heat checks are caused on the tread due to heating and cooling cycles undergone by the wheel during normal braking. Such wheels do not need to be withdrawn but should be carefully distinguished from the rejectable thermal cracks.

Note: All wheel sets withdrawn from service for any of the conditions mentioned above must be sent to the associated workshops for detailed investigations and further disposal.

i. The date and station code of the maintenance depot where the wheels are changed should be stenciled on the end panels. An entry should also be made in the maintenance card of the coach.

ii. The defective wheel should be sent to workshop for repairs after entering in the maintenance card details of the work order and date of dispatch to workshop.

iii. No repairs, except wheel profiling of wheel sets is permitted to be done in the maintenance depot

b) Cartridge Bearing Unit

A coach should invariably be detached from service for the following defects

i) Hot bearing unit
ii) Damaged bearing unit
iii) Loose cap screws and locking plate
iv) Seized bearing unit
v) Coach involved in accident, derailment, fire, flood etc.

Care should be taken not to keep a coach fitted with cartridge taper bearing unit stationary for a long time. Coaches grounded for a long time should be shunted up and down at regular intervals.

4.4.3 Wheel Balancing

For train services running at speed ≥160 Kmph, the wheel sets should be balanced. RCF has issued spec. no. MDTS-168 (Technical specification for Dynamic balancing of wheel sets for FIAT Bogies), which may be referred for procedure/requirements of wheel-balancing.

Recommendations for firms for Examination:

i. Firms should carry out detailed examination of bearing opened for refurbishment and analyze the cause of rejection so that weak areas can be properly identified. Component rejection due to casting an pitting corrosion is very high.

ii. Firms should regularly analyze the components rejection data for improvement in bearings and suggest remedial measures to always for improvement in maintenance practice of the workshops.

iii. Packing of refurbished bearings need improvement the bearing should be properly packed in polytene packing and card board and transported in wooden box.

iv. M/s SKF should submit their CAP of bearing refurbishment to RDSO.

v. M/s SKF should carry out phosphating of outer cup of bearing and take rust preventive measure after cleaning.

vi. Firms should develop Go –No-Go gauge for checking of control arm.

Recommendation for Workshops and Maintenance Depots Examination:

i. Coaches should be taken while examining the phonic wheel assembly during maintenance in open line. Proper tightening of the fasteners should be ensured so that bearing failure due to damage of phonic wheel can be avoided

ii. M8 bolt presently used for tightening of phonic wheel get sheared after some time of service. The quality of M8 bolt should be improved so that it could not shear in services. It is suggested that the material of M8 bolt should be steel to IS 1367 part -3 properly class 10.9. RCF and Railways should include this in the scope of supply of WSP suppliers.

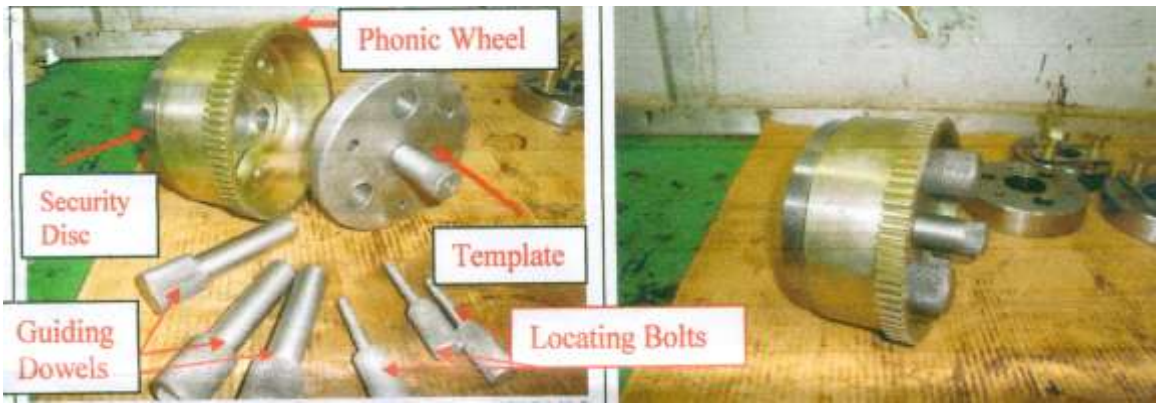
iii. The control arm should be stocked in pair and its dimensions should be mentioned as per maintenance manual.

iv. Drain holes of control arm should be cleaned before fitment of control arm

v. The fastener for mounting earthing device, only Hex head screw ISO 4017-M 8x25, IS 1364(Pt-2) 2002 10.9 CE (Item No. 12 of drawing No. LW 71231 ate e) to be used. Railways should ensure that earthing device is properly maintained.

4.4.4 Instructions for Stepwise Fitting of Phonic Wheel to Security Disc

1 1A



1. Matching security disc & phonic wheel with the help of template guiding dowels.

2 3

2. Cleaning of threaded holes for Burrs/Dust etc.
3. Mount security disc and locking plate with the help Hex Head bolt M 20x60 to torque of 200 Nm with the help of calibrated torque wrench.

4 5

4 Bend the ribs of locking plate with the help of hammer. Mark these bolts with permanent marker for easy identification for their loosening, if occurs later on.

5. Mount the matching phonic wheel with the help of two locating bolts. Hammer slowly with wooden/rubber mallet to seat it properly on security disc.

6 7

6. Apply thread sealant (LOCTITE 572/RITE LOKPS 65 of 3M/DARBOND 2572/MYTLOK 172R) on hex head bolt M8x35 and loosely tighten it into 3rd hole.

7. Remove one locating bolt and provide 2nd hex head bolt M8x35 in its location. Similarly provide the 3rd M8x35/22 hex head bolt M8x35 after removal of another locating bolt. Use M8x35 hex head bolts of Grade 8.8 (Revised by RDSO to 10.9) of reputed make E.G TVS, LPS, Unbrako only.

8 9

8. Finally tighten all the three bolts simultaneously with the specified torque of 21 Nm.

9. Mark these bolts with permanent marker for easy identification for their loosening, if occurs later on.

4.5 THE CARTRIDGE BEARING UNIT

4.5.1 Introduction

The cartridge bearing is a self contained, preassembled, pre adjusted, pre lubricated, enclosed tapered roller bearing unit, and is applied to and removed from the axle without exposing the bearing elements, or lubricant to contamination or damage.

The preassembled cartridge bearing reduces the number of separate parts to be applied to the axle assembly to a minimum.

See FIG. 4-54 for sectional view identifying the component parts of the bearing assembly.

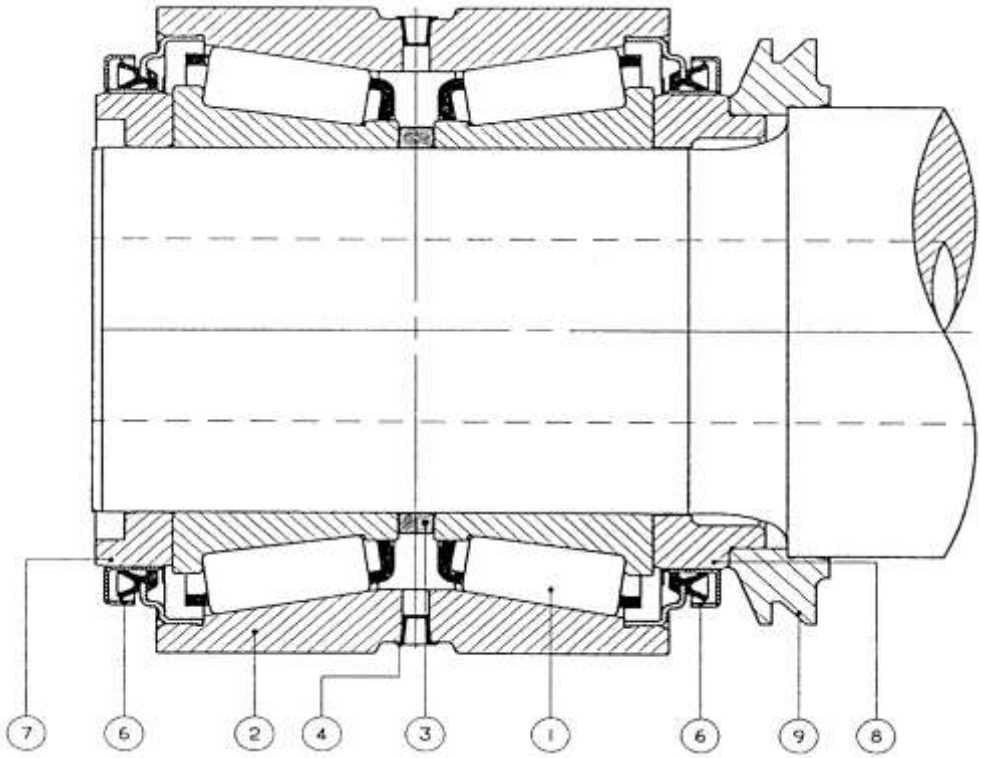


FIG. 3-54 Bearing Unit Sectional View

REF	DESCRIPTION	QTY	PART NO	DRG.NO.	WEIGHT (Kg)*
1	CONE ASSEMBLY	2	H127746		6.544
2	DOUBLE CUP	1	-H127715AD	C-45087	13.765
3	CONE SPACER	1	H127748XA		0.274
4	PLASTIC PLUG	2	K 145179	A-49710	0.001
5	GREASE	1	GR59	A-47647	0.400
6	HDLtm~ SEAL	2	K151139	E-37856	0.500
7	BACKING SPACER	1	K153064	C-50014	1.393
8	SEALING RING	1	K153063	C-50013	1.864
9	BACKING RING	1	K153065	C-50017	2.455
					TOTAL 34.241

* WEIGHT BASED ON NOMINAL COMPONENT DIMENSIONS
LUBRICANT DETAILS: GR59 represents 400 grams of Shell Lube 2760B grease.

4.5.2 Bearing Removal

General Description

Whenever bearing assemblies that have been in service are removed from the axles. the bearings should be disassembled, cleaned, inspected, and repairs made as necessary in accordance with the instructions.

The bearing assemblies may be removed with a bearing press, wheel press, or with portable jacks. Thirty to forty tonnes pressure may be required to break the bearing fit.

Pressure must only be applied to the backing ring to remove the bearing. If bearings are to be removed along with the wheels, a suitable shoe must be used to make contact between the wheel hub and backing ring withdrawal face.

When bearings are removed from the axle, a pilot sleeve should be fastened to the end of the axle or to the press ram to keep the bearing parts together and protect them from damage. Do not drop the bearing assembly when removing it from the pilot sleeve.

After the bearing assembly is removed from the pilot sleeve, a cardboard insert or a similar device should be inserted in the bore of the bearing assembly to hold the internal bearing parts in place.

Removing the Bearing

Note: Special device drives should be removed prior to the removal of the wheel and axle assembly from the bogie frame.

Thoroughly clean the bores of the housings, remove all rust or corrosion and apply a heavy coating of grease to the bores.

Bend the tabs of the bolt locking plate away from the heads of the bolts.

Remove the bolts, locking plate, and axle end cap.

Fit the Pilot Sleeve to the axle end.

A withdrawal and pulling ring adapter, which fits behind the backing is used to remove the bearings when it is desirable to remove the bearings without removing the wheels.

Ensure that the withdrawal plate and pulling ring adapter is of the correct size for the bearing to be removed. Proper contact with the backing ring and puller alignment are necessary for efficient bearing removal.

Position the withdrawal plate behind the rear face of the backing ring. To ensure maximum contact area it may be necessary to hold the plate down in position behind the backing ring until the initial pressure has been applied.

Extend the ram to remove the bearing from the axle.

Equipment

Bearings may be installed or removed with a bearing press, wheel press, or with portable jacks, depending on requirements and availability of equipment.

Roller bearing work should be confined to a specific area.

Machines and tools designed for roller bearing installation and removal should be used.

Bearing press or Wheel presses

Where the bearing is applied by a bearing press or wheel press, a pilot sleeve is fastened to the end of the axle, and a separate assembly sleeve is to be used.

To ensure that bearings are properly seated, bearing presses should be equipped with a pressure gauge so that the specified pressure can be maintained for a short period, otherwise bearings may not be properly seated.

Bearing presses or wheel presses should be checked with a load cell to be sure that the ram pressure, as indicated by the gauge, is correct in the tonnage range and for the piston travel required for applying cartridge bearings to axles.

When bearing or wheel presses are used for bearing removal, the equipment shown in FIG. 4-55 should be used.

The withdrawal plate and puller rods required to attach the fixture to the bearing press should be designed to suit the specific press conditions.

Bearing removal instructions

1. Check the condition of the bearing before removing from the axle. Check for cracked cups, loose, cocked or damaged seals, loose or missing cap screws and cracked or broken end caps. If any damage is observed record the same.

NOTE:

1. Bearings must be sufficiently clean to permit adequate inspection of all exterior pats.

2. If any damages are found, check mate bearing & condition of wheels & record the findings.

3. Always remove bearings in accordance with operating instructions provided by the manufacturer of bearings. Use tolling specified for the purpose.

4. Protect the bearings removed from the axle from dirt and moisture until they are sent to the OEMs for inspection and repair.

WARNING:

Proper bearing maintenance and handling practices are critical. Failure to follow correct installation instruction can result in equipment failure, creating a risk of serious bodily harm.

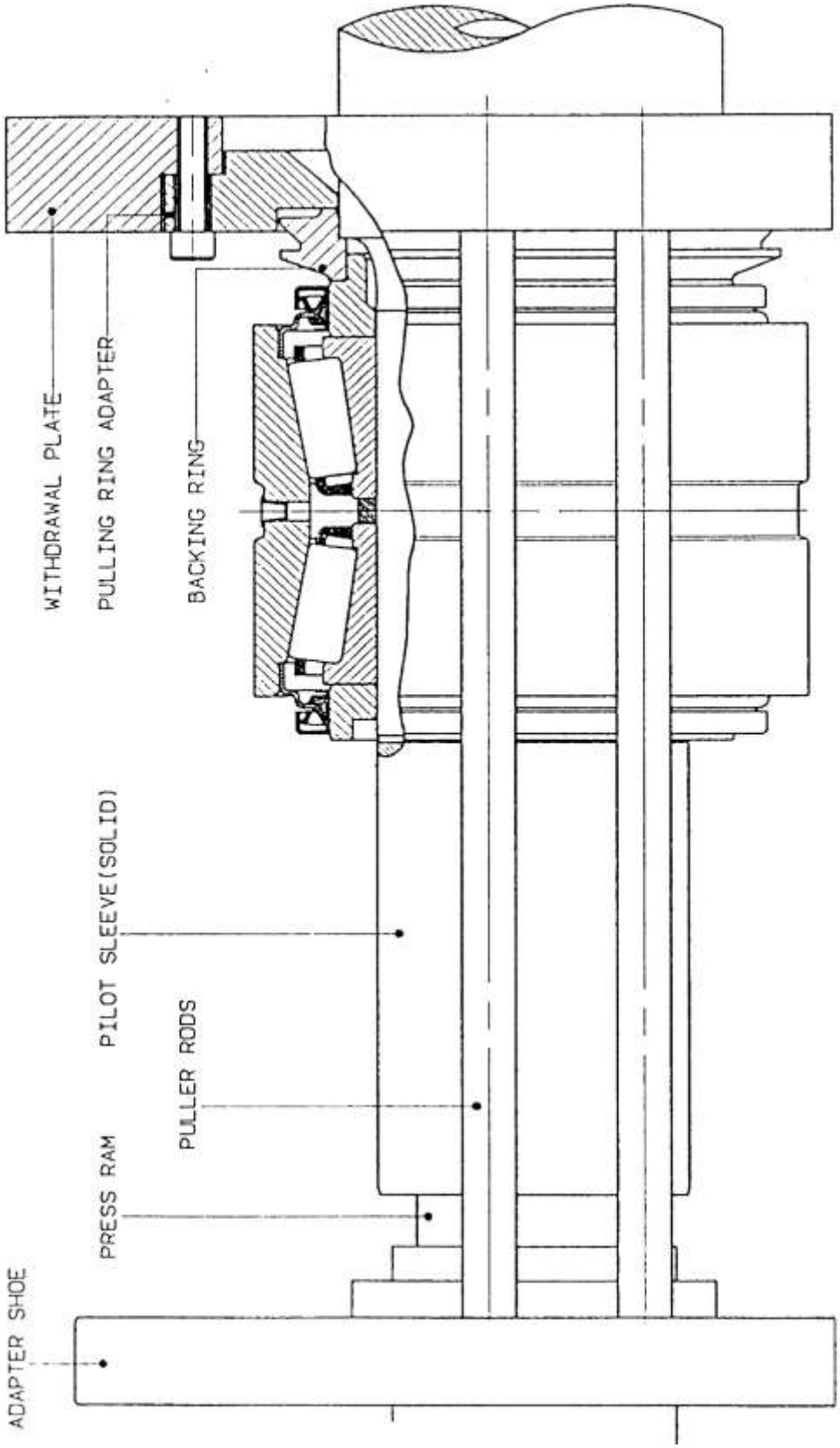


FIG. 3-55 Bearing Removal Equipment

Axles

Before proceeding with the bearing installation, the axles should be checked under uniform conditions of temperature to make sure that the bearings can be applied without difficulty and that the axle is to specification.

Axles should be checked on the bearing seat diameters, shoulders and radii with proper gauges to determine that finished axle dimensions are within prescribed tolerances shown in FIG. 4-56, to obtain proper fit of the cone assembly, backing ring and backing spacer.

Micrometers used to measure the bearing seat diameters of axles should be checked for accuracy with a disc micrometer standard.

Micrometers and disc standards should be of the same temperature as the work. Axle diameters should not be checked while the axles are heated due to machining.

Axle bearing seat diameters, shoulders, and radii should have a smooth machined and rolled, or ground finish, and must be free from sharp corners, burrs, nicks, tool marks, scratches, or corrosion.

Axle bearing seat diameters should be concentric with the wheel seat diameters.

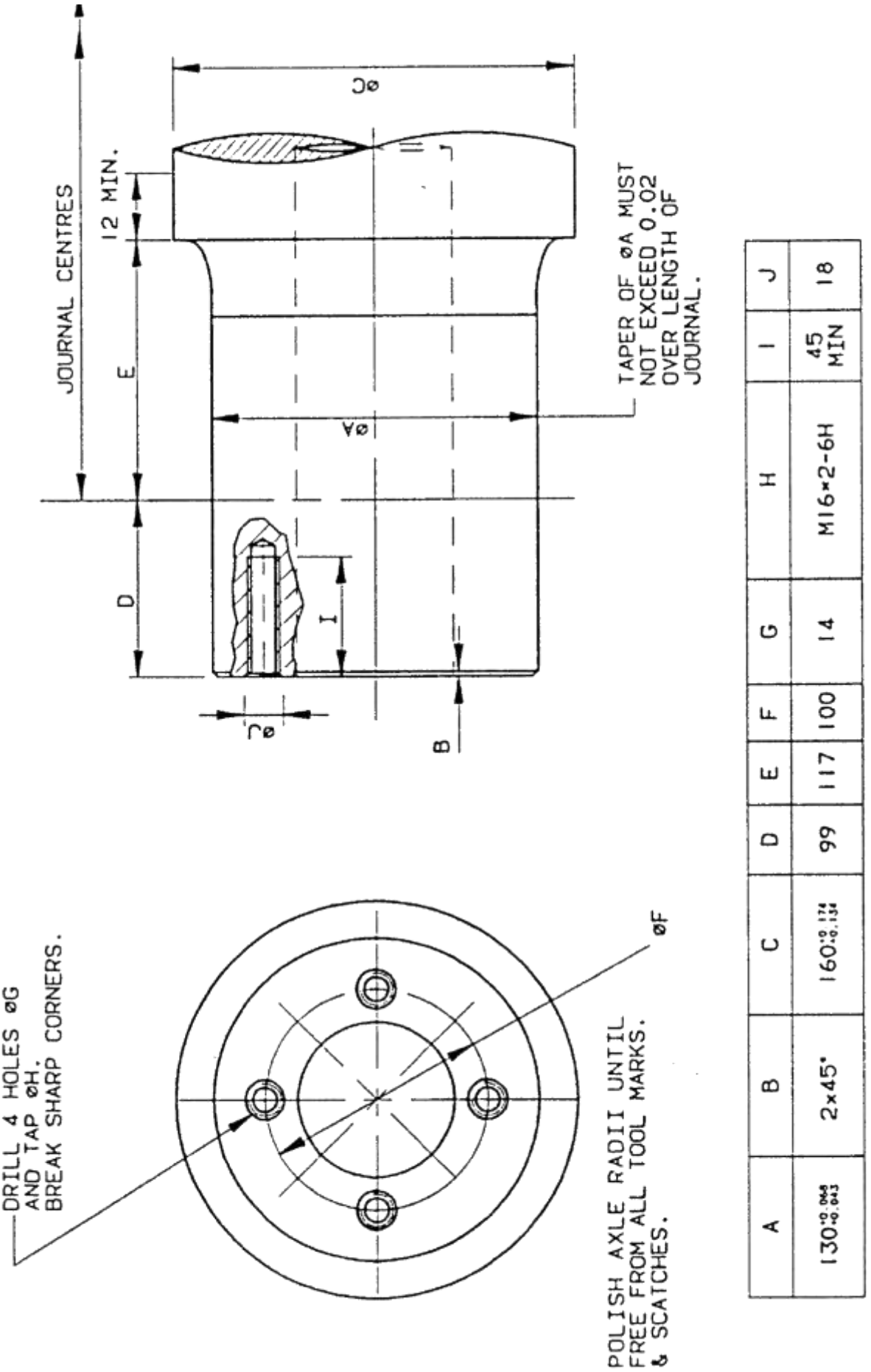
Axle journals should be protected if there is a possibility of damage or deformation resulting from mis-handling, or uneven pressures being applied to the axle ends.

The bearing seat diameters should be carefully measured with a micrometer after the wheels have been applied to the axles to determine whether any high spots exist. Any roller bearing axle found with high spots should be carefully reground for the full circumference and length of the bearing seats. The refinished axle must be within the prescribed tolerance limits.

All steel chips, dirt, and grease must be cleaned out of the lathe centres and bolt holes in the ends of the axle before applying the bearings.

The bolt holes in the ends of the axle should be checked with a bolt circle checking gauge, and a "go/no go" thread plug gauge.

Axles that have become magnetised must be demagnetized before bearings are applied.



A	B	C	D	E	F	G	H	I	J
130 +0.043 +0.013	2×45°	160 +0.174 +0.134	99	117	100	14	M16×2-6H	45 MIN	18

FIG. 3-56 Axle Dimensions

4.5.3 Checking the Bearings

Checking Bearing Mounted End Play

Check the bearing mounted end play with a dial indicator mounted on a magnetic base. Place the magnetic base on the axle end and position the indicator stem against the face of the cup, marking the position on the cup.

With the dial indicator in position, pull hard but steadily on the bearing cup and oscillate at the same time. Without releasing the pressure, steady the cup so that the indicator stem contacts the marked spot, and note the reading on the indicator dial. Then push the bearing cup hard and oscillate as before, turn the cup until the stem of the indicator contacts the marked spot, and without releasing the pressure take a second reading. The difference between the two readings is the amount of mounted end play in the bearing.

If bearing end play as indicated by the dial indicator is less than Minimum "MEP at installation" or more than Maximum "MEP at installation", remove the bearing assembly from the axle. Minimum and Maximum end play values are shown in the following table:

Bench End Play (mm)	Mounted End Play at installation (mm)
0.58 - 0.64	0.096 - 0.330

The bearing mounted end play may be corrected so as to fall within the specified Iimits by one of the following methods:

1. Check the bearing seat on the axle for size and condition. If the size or condition of the axle is not according to specification, correct any undesirable condition found and reapply the bearing.

   If a bearing was applied to an over-sized axle, check the size of the cone bores before reapplying the bearing.

2. If the size and condition of the axle are satisfactory, but the end play indicated was less than Minimum apply the bearing to an axle having a bearing seat diameter nearer the minimum dimensions, but within the specified tolerance.

3. If the size and condition of the axle are satisfactory, but the end play indicated was more than Maximum apply the bearing to an axle having a bearing seat diameter nearer the maximum dimension, but within the specified tolerance.

If the bearing mounted end play is still not within the specified limits, remove the bearing from the axle.

Prior service bearings removed from axles because of improper mounted end play should be disassembled. The bench end play and the bore of both cone assemblies should be re-checked. The bearing seat diameter of the axle from which the bearing was removed should also be checked for size.

Lubricant Contamination

Lubricant containing water is destructive to roller bearings, causing rapid wear. All possible precautions should be taken to prevent water from entering the bearing assembly. 1f the equipment has been submerged or operated through water of such a depth that the water could have entered the bearings, the bearing assemblies must be removed from the axle, disassembled, cleaned, inspected, and replacements or repairs made as necessary.

When cleaning the exterior of equipment, the stream of water should not be directed at the bearing seals. When sandblast or shot blast cleaning of the vehicle, a shield should be provided to protect both the front and rear of the bearing assemblies from sand or shot. Tunnel cleaning machines, high pressure sprays, sandblast or shot blast cleaning of roller bearing equipped axle assemblies is not recommended.

Lubrication

The cartridge bearing is pre lubricated at the factory. No additional lubricant is to be added after the bearing is applied to the axle.

4.5.4 Service Inspection in shop

General

Bearings should be given a visual inspection at terminals, and when equipment is on repair track or in the shop for tyre turning or for other reasons. Inspect for overheating, roughness when bearing is revolved, excessive lubricant leakage, broken, loose, or missing parts such as axle end caps, loose bolts, loose or defective seals, cracked or broken cups, end caps and housings. Examine the outside of the bearing for damage or distortion

Loose or Missing Axle End Bolts

Note: If one axle end bolt is found loose or missing, remove all of the bolts, fit new locking plates, refit all of the bolts and tighten to the correct torque. Bend all tabs against the flats of the bolt heads.

Note: If two or more axle end bolts of different pairs are found loose or missing, the wheel set must be removed from the truck. Remove the end cap, if there is any evidence that the bearing is not properly seated, or if the end play is more, remove the bearing from the axle for a complete inspection to determine the cause and possible resulting damage.

Bearing Running Temperature

(Ref: W.Rly letter no. M 442/19/4 (LHB) dated 18/21.03.2006.)

During enroute/terminating examination, non-contact type infra-red thermometers shall be used to check the axle box temperature of LHB coaches. The location at which the temperature is to be checked/felt is indicated in W.Rly Drg. No. C/LHB-002/H. If abnormal temperature rise in an axle box as compared to other axle boxes is found, action should be taken as under-

i)	Axle box temperature below 65 degree centigrade.	No action
ii)	Axle box temperature 65 degree centigrade or above but less than 80 degree centigrade.	Information to be given to next halting station through control for checking the temperature of the box. Traveling C&W supervisor to be informed who will also check the temperature by the thermometer available with him.
iii)	Axle box temperature 80 degree centigrade or more	Coach should be withdrawn from service.

Infra- red non contact thermometers being used by divisions should be got calibrated to ensure correct measurement.
When a bearing is damaged to the extent that the wheel and axle must be removed, the housing must be sent to the shop along with the wheel and axle assembly to determine the cause of damage.

Displaced Housings

A housing out of position causes a load concentration on the bearing and if continued in service for any length of time may result in serious bearing damage.

4.5.5 Shop Practice

Bearing Inspection at Frame or Bogie Disassembly

Frames must not be permitted to strike the roller bearings when removing the frames from wheel and axle assemblies.

Remove the housings and clean the outside surface of the bearings. Sandblast or shot blast cleaning of roller bearing equipped axle assemblies is not recommended.

Housings should be cleaned and inspected for excessive wear. Housings worn to the extent that proper load distribution on the bearing is affected should be repaired or replaced.

Rotate the bearing assemblies to detect any abnormal condition and visually check the outside of the bearing assembly for broken, loose, or missing parts.

Check the bearing mounted end play, if the bearing end play is outside the limits specified, or if any roughness is detected when the bearing is rotated, the bearing assembly should be removed from the axle. Whenever the bearing assemblies are removed from the axle, due to excessive end play or roughness, the bearings should be disassembled, cleaned, inspected, and reassembled in accordance with OEM"s instructions.

Wheel Turning

It is not necessary to remove the bearing assembly during wheel turning, but the bearing assembly must be suitably protected to prevent any steel chips from damaging or entering the bearing. Heavy grease must be used to lubricate the lathe centers.

DO NOT USE WHITE LEAD.

After the wheel turning operation has been completed, clean the end faces and centre holes and bolt holes of the axle. Reapply the end caps, using new locking plates, and torque tighten the bolts in accordance with installation instructions.

Electric Welding

Whenever it is necessary to do any electric welding on cars, or wheel and axle assemblies equipped with bearings, the ground cable must be clamped to or near the part being welded so that **NO CURRENT WILL PASS THROUGH THE BEARINGS.**

4.5.6 Bearing Installation

General description

Cartridge bearings must be pressed on the axle. Heat must not be applied to the bearing cone assemblies to facilitate installation.

The bore of bearing cones that have had previous service should be checked for acceptability before being pressed on the axle to ensure a suitable interference fit. Oversize bearing cones should be scrapped.

Coat the bearing seats of the axle with castor oil, heavy mineral oil, or a molybdenum-disulphide and oil mixture. DO NOT USE WHITE LEAD. Lead compounds may be detrimental to lubricating greases by acting as an oxidation catalyst.

To minimize the risk of ingress of water through the backing ring contact area with the axle, apply a sealant to the backing ring/axle interface as shown in FIG. 4-63.

A thin coating of a quick-drying rust preventative must also be applied to the portion of the axle between the wheel hub and the bearing. The rust preventative used must not contain lead or other compounds which may be detrimental to lubricating greases.

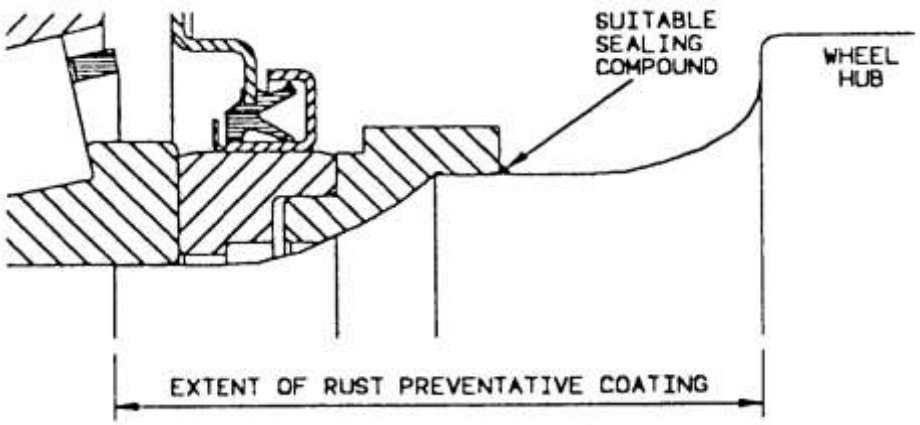


FIG. 3-63 Installation Requirements

Pressing Bearing Assemblies on Axles

Place the wheel and axle assembly in a wheel press or bearing press, in position to press the bearing assembly on to the axle. Fit the pilot sleeve onto the end of the axle, using the screws to hold it in position. Slide the bearing assembly over the pilot as far as it will go and place the assembly sleeve behind the bearing assembly. See FIG. 4-64. Apply pressure to the end of the assembly sleeve until the bearing assembly is correctly seated.

To ensure that the bearing is firmly seated against the axle fillet, the pressure indicated on the gauge during pressing-on should be increased by 50%. This 50% increase should be applied after the surge of pressure indicates on the gauge that the bearing assembly has contacted the axle fillet. This seating load pressure should be within the limits shown in the table below.

Caution should be used when applying the seating load, otherwise damage may be caused to the backing ring, seal sleeve or backing spacer. On no account should the momentary seating load applied be any more than the maximum pressure shown in the following table:

SEATING LOAD (tonnes)
20-25

Rotate the bearing assembly to ensure that it will turn freely at initial application. New bearing assemblies are pre adjusted at the factory. No adjustment is necessary at installation. After the press rams have been retracted, roll the wheel and axle assembly out of the press. Remove the assembly sleeves and bearing pilot sleeves.

Fitting of bearings by means of portable jacks is carried out in accordance with the operating instructions of the equipment. These jacks can be hand or electrically operated, pumps and jacks are available commercially to suit production requirements.

The hydraulic ram or jack used should have sufficient travel to install or remove the bearings in one operation without the use of intermediate blocking.

To fit the second bearing to the opposite end of the wheel set, care must be taken to ensure that the first bearing fitted is not subjected to further transmitted pressure.

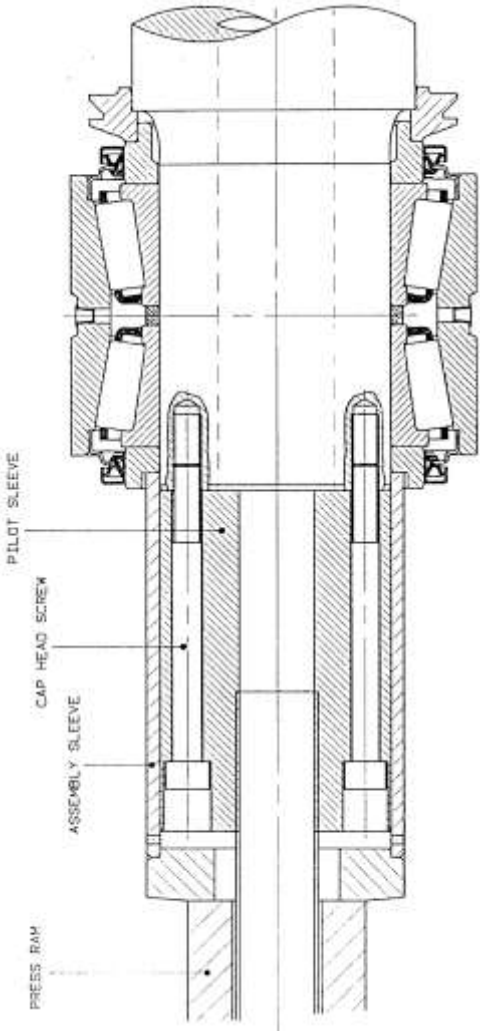


FIG. 3- 64 Bearing Installation Equipment

Applying the Axle End Cap

Apply the axle end cap. Apply the locking plate and hexagon head bolts.

A ratchet wrench or an impact wrench may be used to “run-up" the bolts.

Tighten the bolts with a torque wrench. Recheck each bolt several times until the bolt does not turn when the specified torque is applied.

Lock the bolts by bending all tabs of the locking plate flat against the sides of the bolt heads using adjustable rib -joint pliers.

Do not tighten or loosen a bolt after the specified torque has been obtained to position the bolt head flats relative to the locking plate tabs.

Bearing installation instructions

1. Check Axle journals, fillets and dust guard diameter for any damages before applying bearings

2. Ensure that the journal diameter & dust guard diameters are within the specified limits. DO NOT assemble bearings if these diameter are outside the specified limits.

3. Coat the axle journal with an approved press –fit lubricant prior to applying bearings **DO NOT USE WHITE LEAD MIXTURES.** Apply a moderate to heavy coating of approved anti-rust compound to the axle and dust guard fillets up to the wheel hub before the bearings are applied.

4. Check the bearing to be mounted for damaged seals or any other visual defects. DO NOT mount bearings with any defect. Contact OEMs representative immediately.

5. Ensure that the bearings are mounted with appropriate tooling meant for the purpose.

6. The mounting press should be calibrated and should have the capacity for the seating tonnage of the bearing.

7. Press the bearings on the axle journal and allow the pressure to build up to the tonnage specified. (see maintenance manual) in the table after the bearings have seated against the axle fillet.

   NOTE: Be careful during mounting as the backing ring may separate from the bearing.

8. Inspect cap screw threads, cap screws that are damaged, worn or that cannot be tightened to the required torque must be replaced.

9. Apply the axle end caps and tighten the cap screws with a torque wrench to the torque specified (see OE specification). RECHECK EACH CAP SCREW SEVERAL TIMES UNTIL THE CAP SCREWS DO NOT MOVE WHEN THE SPCIFIED TORQUE IS APPLIED.

   NOTE: Ensure that the torque wrench is calibrated. Endcaps that are distorted, damaged or cracked should be used and must be replaced with new.

10. Lock the cap screws by bending all of the locking plate taps flat against the sides of the cap screw heads.

    NOTE: Do not re-use locking plates.

11. Check the bearing lateral play with a dial indicator mounted on a magnetic base. Revolve the bearing several times while forcing the bearing cup towards the wheel hub. Position the dial indicator as shown in the photo. Pull the cup away from the wheel hub. The bearing lateral should be between 0.099-0.389 mm. If a tapered roller bearing rotates freely by hand, but indicates less than 0.099 lateral on the dial indicator, the application is satisfactory for service.

The information is to be used as a guide. It is not intended to replace OEM equipment manufacturer‟s operating instructions or you company procedures.

Bearing Storage

1. Un-mounted / New roller bearings and component parts must be stored in an area that is clean well protected from moisture/ rain.

2. A Periodic inspection of stored roller bearings should be made. Any undesirable condition (bearing assemblies subjected to moisture) found should be intimated to the Company immediately.

3. Roller Bearings, either new or used, that are placed in storage as individual parts or as bearings assemblies, should be used in the order in which they were stored, oldest stock first.

4. New roller bearings and component parts should be removed from the shipping package until they are to be installed on to an axle.

5. When new roller bearing parts are removed from storage it is not necessary to clean the protective coating the parts that have been retained in their original shipping package.

6. When bearings that have had previous service are disassembled, cleaned, and inspected in accordance with the instructions and are to be placed in stock, may be stored as complete assemblies or as individual parts.

7. When loading or unloading wheel and axle assemblies with bearings applied, wooden boards should be placed between the bearing cups and the wheel flanges of adjacent wheel and axle assemblies to protect the bearings from damage.

The first incident report of bearing failure

Railways should send First Incident Report of bearing failure, including mate bearing to RDSO containing following details (Ref Annexure 12.9)

a. Wheel condition

b. Torque value of bolts when removed (use method to mark position loosen one by one and torque back to mark and record)

c. Journal size at 9 points.

d. Bearing pictures of the seal for future

e. Weigh the bearing to confirm grease fill.

f. A grease sample kept. For possible future use.

g. Detailed inspection of cage for cracks and cage date to try and narrow down and link to failed bearing.

h. Comment of raceway condition and roller end condition this is important to establish root cause.

i. A picture and comment of adaptor to cup contact pattern to understand load path.

Wherever bearing is sent for refurbishment, it may be ensured that a representative from the Workshop is available when the bearings are opened.
In order to prevent bearing damage the following may be checked on line and workshop.

Online checks- Bearing damage

a. Monitor bearing temperature and compare with mate bearing on same axle and bearings on same coach. Any bearing with unusual high temperature should be suspect.

b. Check for looseness of front covers and also bottom strap of control arm.

c. Check for missing front cover screws and also screws holding top and bottom strap of control arms.

d. Check for displaced or cracked control arms.

e. Check for heat/burn marks on the control arm/covers.

f. Check for dislodged /open speed sensor cables.

Workshop checks- Bearing damage

a. Wheel size specification: Ensure that the wheel sizes are to the required specification on the same axle, on the same bogie and coach.

b. Check for wheel flats and shelled wheels.

c. Check for looseness of front covers and also bottom strap of control arm.

d. Check for excessive grease seepage on the bearings.

e. Check for missing phonic wheel screws and/ or end cap screws.

f. Check for looseness of phonic wheel screws and/ end cap screws.

g. Check for damaged seals.

It is also imperative that the failed wheel set should be sent to the workshop for a through investigation.

For complete details of CTBU/TBUs of LHB Coaches, Please refer to CAMTECH Publication Doc. No. IRCAMTECH/M/12-13/Bearing/1.0, Dec-2012 **"Hand Book on Maintenance of Spherical Roller Bearing for ICF Coaches, CTBUs/TBUs for LHB Coaches & CTRB for Freight Stock In Workshops.**

4.6 BOGIE ASSEMBLY

4.6.1 General Note

Before starting, it is necessary to clean the bogie frame and in particular all the threads and the seats for the bump stops, the dampers, the rubber elements, etc.

All rough surfaces and screws must be well greased with AUTOL TOP 2000.

- Security plates and split pins can be used only once.
- When dismounting screws and other fixings at revision, replace them with new ones.

4.6.2 Mounting Assemblies

In the following paragraphs it is described how to pre-mount the assemblies that will be installed on the bogie later.

4.6.2.1 Insertion of the Rubber Joints

Clean the control arm (3 - FIG. 4-65) hole and lubricate with AUTOL 2000. Clean the rubber joint. Mount the rubber joint using the press (4). After mounting, check parallelism using the tool nr. 12.841.0502. The differential tolerance is ±0.5 mm. If necessary perform the required correction. Mount the rubber joints (1) into the anti-roll bar vertical rods (2) and on the traction rods (5) using the press (4). Mount also the bush (6) into the traction lever (7) using the same press.
Use below listed special tools for mounting the different components:

Control arm joint mounting tool	12.613.0402
Anti-roll bar joint mounting tool	12.695.0171
Traction centre bush mounting tool	12.695.0174

1. Rubber joint
2. Anti- roll bar link
3. Control arm
4. Press
5. Traction rod
6. Bush
7. Traction lever

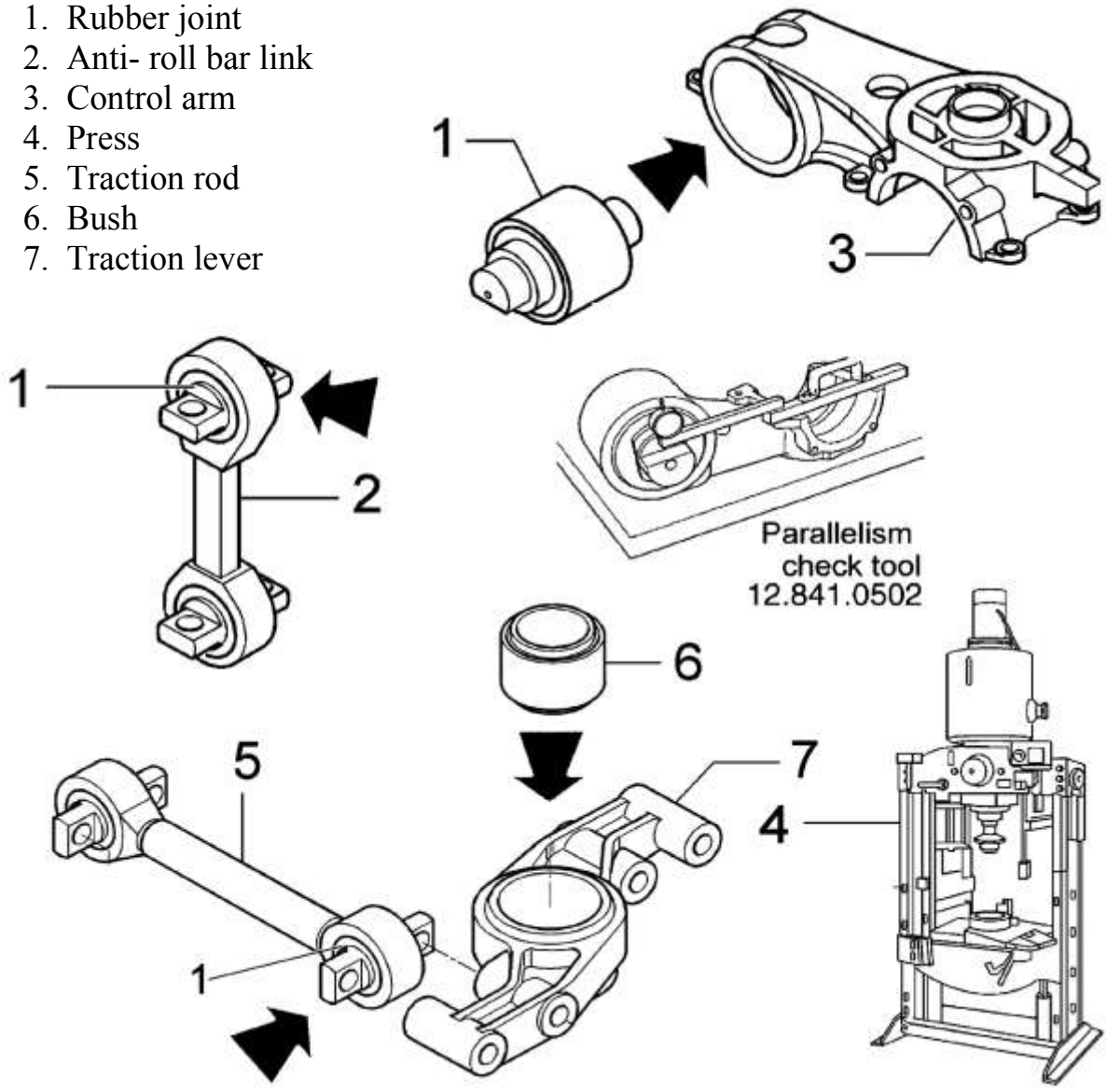


FIG. 3-65 Insertion of the Rubber Joints

4.6.2.2 Pre-Mounting the Anti-Roll Bar

Assemble the anti-roll bar as shown in FIG. 4-66 : respect the shown mounting angles and the tightening torques for nuts and screws. First mount the brackets (6), the bush (12) and the bearing (11), the distance holders (9) and the sealing rings (10).
Then mount the anti-roll bar links (1).

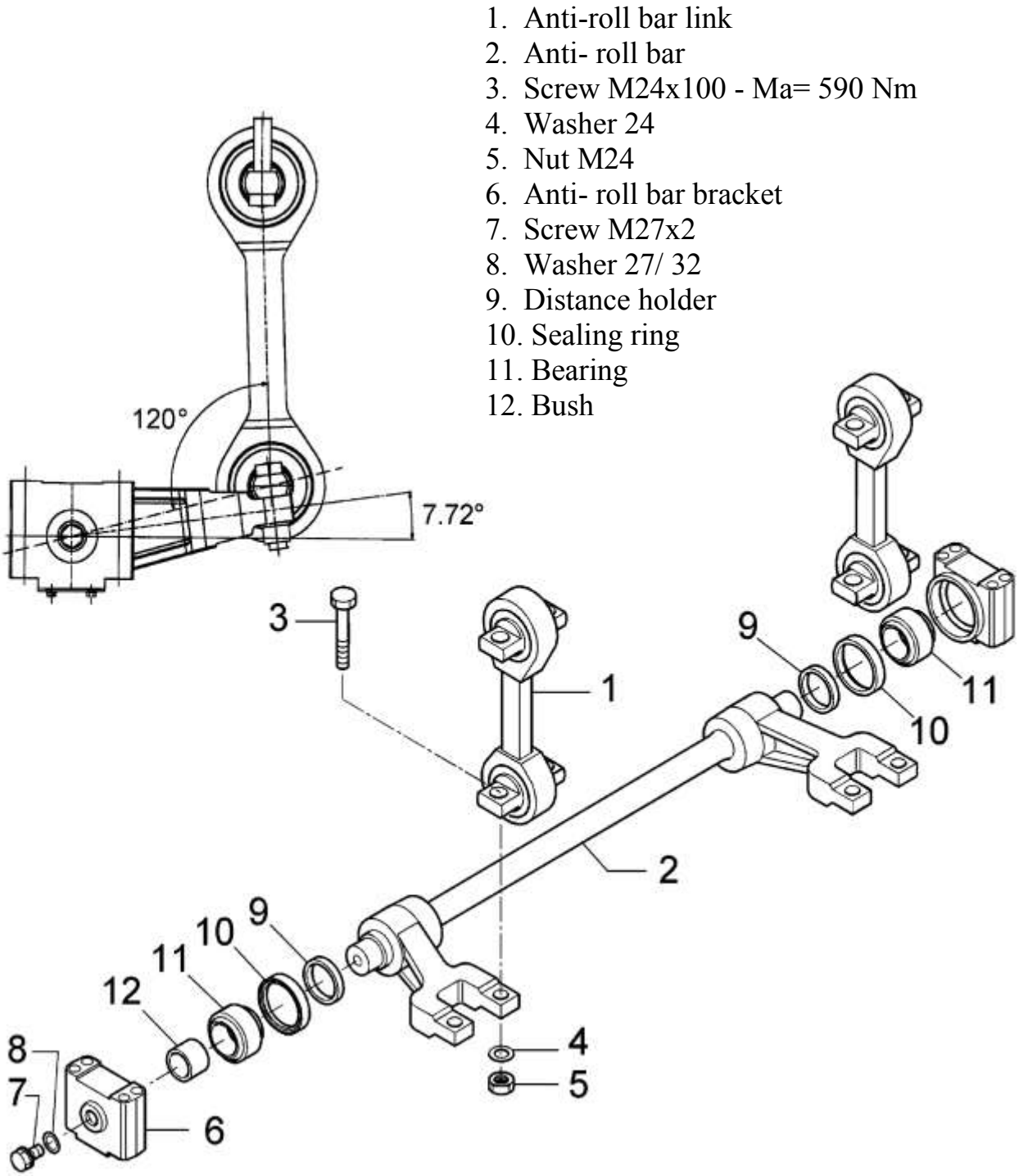


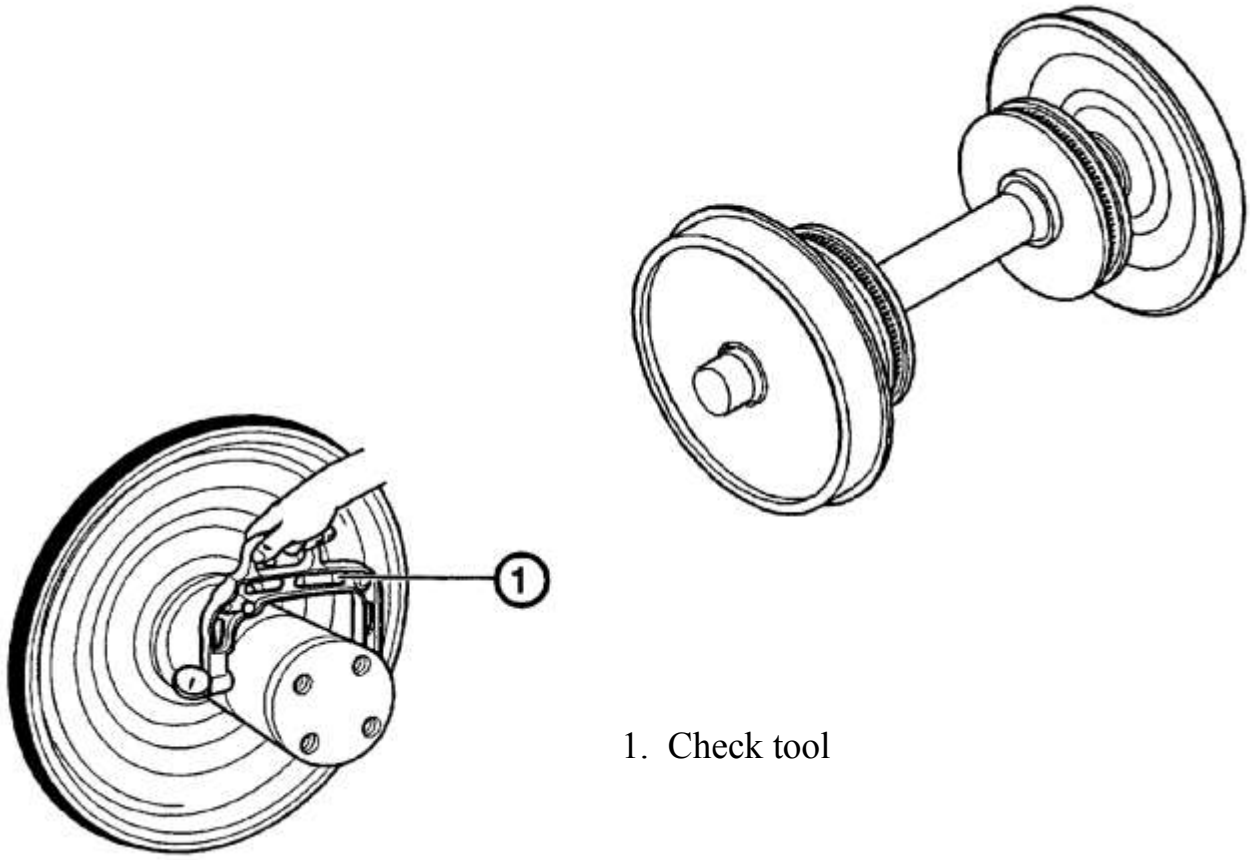
FIG. 3-66 Anti- Roll Bar Assembling

4.6.3 Mounting the Axle Bearings on the Wheel-set

Remove dirt and anti-rust protective paint.

Check the shaft sides for hit marks or corrosion. Eliminate them using fine rectifying tools. The bearing seat must be plain, free from lines and notches. In case of magnetised shaft it is necessary to de-magnetise it.

Measure the shaft side using the tool (1, FIG. 4-67). The concentricity error measured in three different points must be lower than 0,02 mm. The shaft taper error must be lower than 0,025 mm. At the shaft end, check that the hole threads are not damaged and are parallel to the shaft axis. Also check the shaft diameter.



1. Check tool

FIG. 3-67 Shaft Check

Refer to FIG. 4-68. Grease the shaft using ESSO BEACON 2 (1). Screw the guide bush on the shaft (2) using a torque key SW24. Push the bearing on the guide bushing (3). Prepare the press in front of the bearing (4). Check that the press is working properly (5). Put the mounting support (12.695.0112) on the press (6).

- Guide bush tool nr. 12.695.0162
- Press tool nr. 12.613.0399
- Lock rod with profiled element tool nr. 12.695.0400

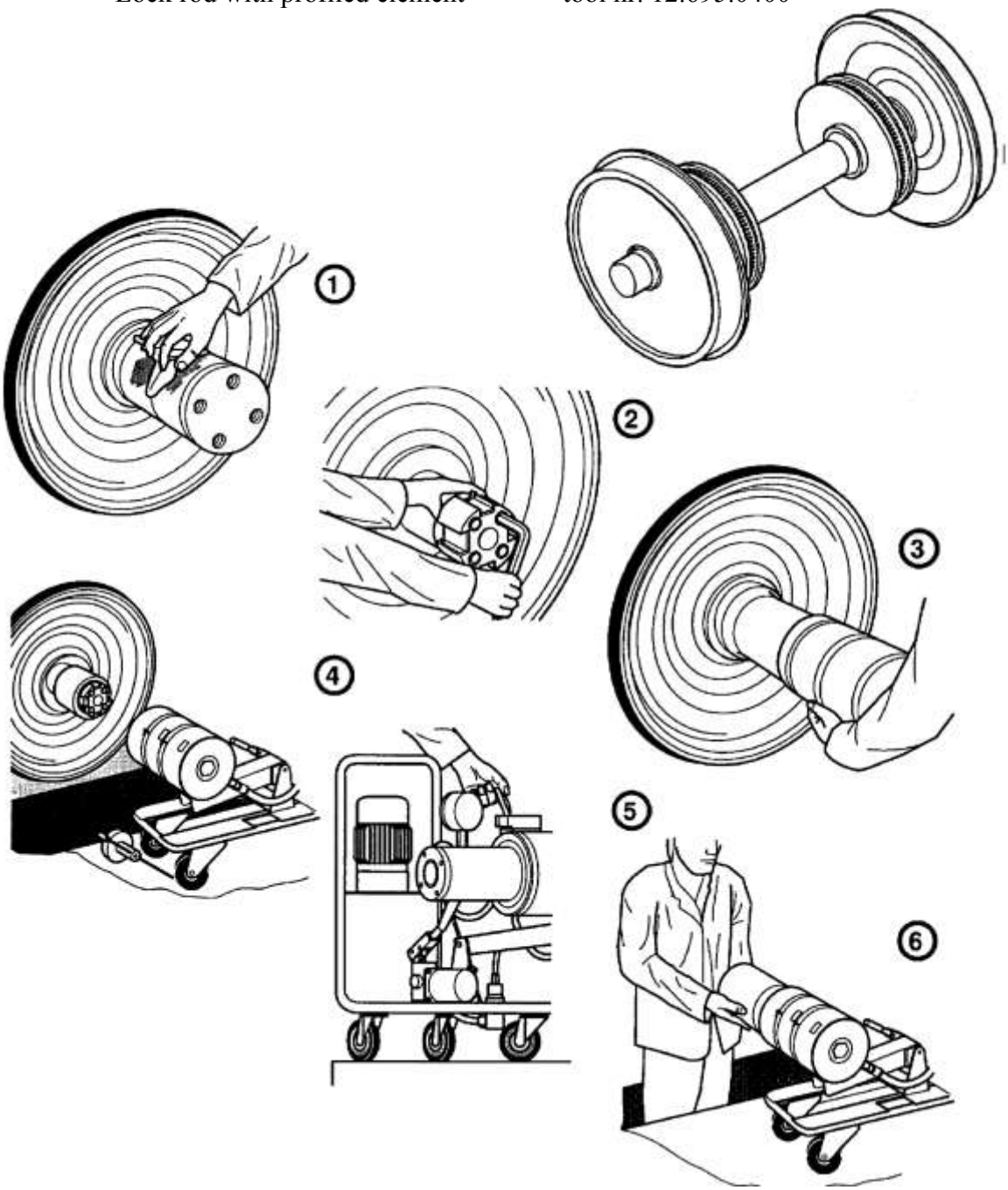


FIG. 3- 68 Bearing Mounting Preparation

Refer to FIG. 4-69. Position the press in front of the shaft end (1). Screw the press to the guide bush on the shaft (2). Push the bearing on the shaft using the press while rotating the external ring by hand in order to avoid blocking the internal rollers. During the bearing insertion, the max pressure reached on the shaft must be 50 kN more than the press working pressure. Check it using a pressure sensor (4). Unscrew the mounting support from the bearing (5).

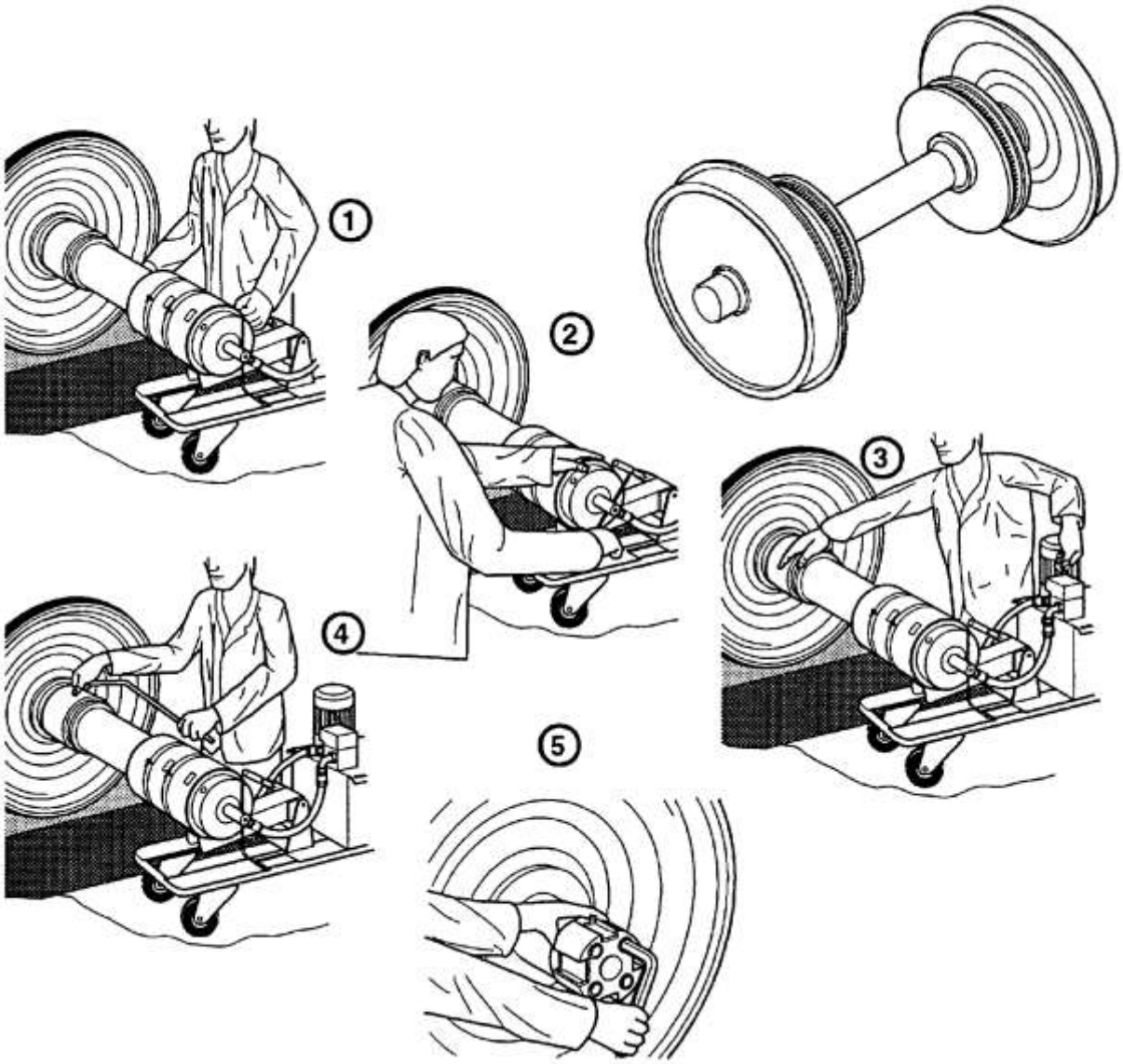


FIG. 3-69 Bearing Mounting With Press

Finally, mount the safety disc (1 - FIG. 4-70) on the bearings. Insert the screws (3) which fix the safety plate (2) and the disc (1) and tighten them.

1. Safety disc
2. Safety plate
3. Screw - Ma= 200 Nm

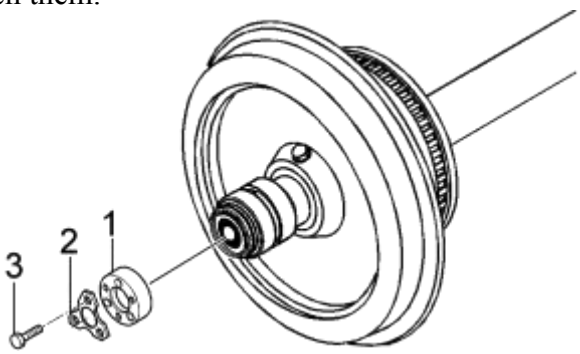


FIG. 3-70 Mounting Safety Discs

4.6.4 Mounting the primary suspension

Before starting, it is necessary to rotate the bogie frame from normal position to reversed. Proceed with assembling the primary suspension according to FIG. 4-71 : first mount the centring disc (17), the bump stop (13) and the disc (16) with the nut (14) and washer (15). Put the centring disc (12) and the pad (18) on top of the springs and insert the spring pack carefully into the frame seat. Put the control arm under press as shown in Fig. 4-72 and raise the pressure with care, checking the correct centring of the pack into its frame seat. Then assemble the spring pack according to the diagram shown in FIG. 4-73 for a correct positioning of the internal (11) and external (10) springs. Fix the control arm (1) to the bogie frame mounting the blocks (5). Each time use a new security plate (7). After tightening the screws (6) to the required torque, bend the edges of the security plate (7) onto the screws (6) to lock them. Mount the safety pin (2). After mounting, release pressure carefully until the control arm end bracket engages the pin (2).

1. Control arm
2. Safety pin
3. Split pin
4. Washer
5. Block
6. Screw M20x 100/46-Ma=170 Nm
7. Security plate
8. Washer 20
9. Threaded pin
10. Outer spring
11. Inner spring
12. Centring disc
13. Bump stop
14. Nut M12 - Ma= 70 Nm
15. Washer 12
16. Disc
17. Centring disc

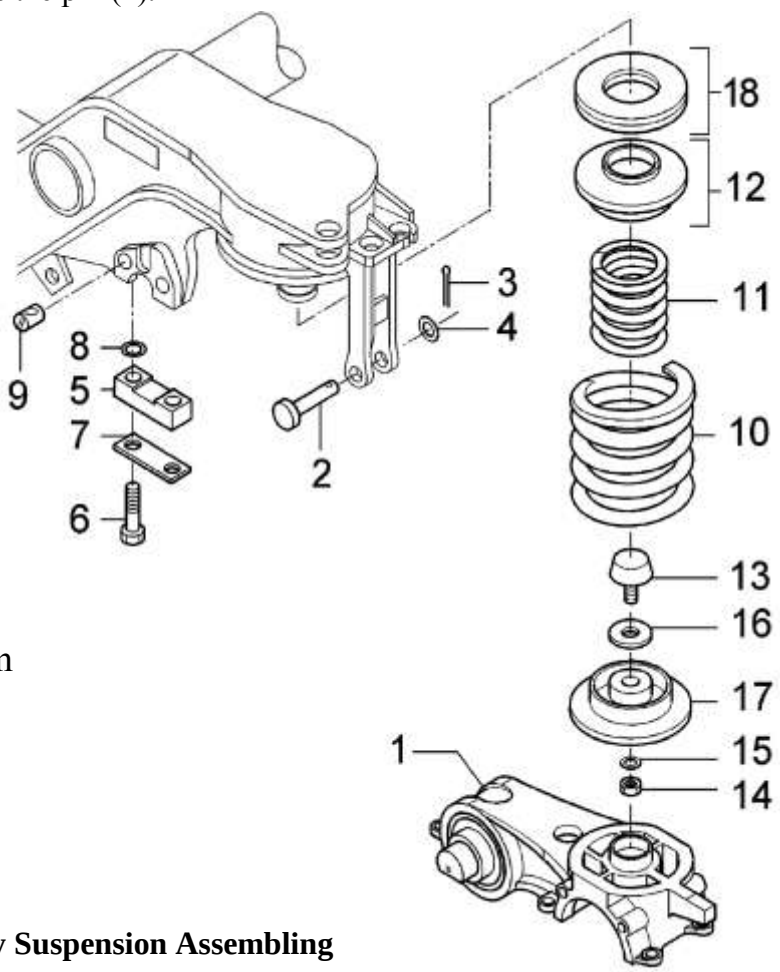
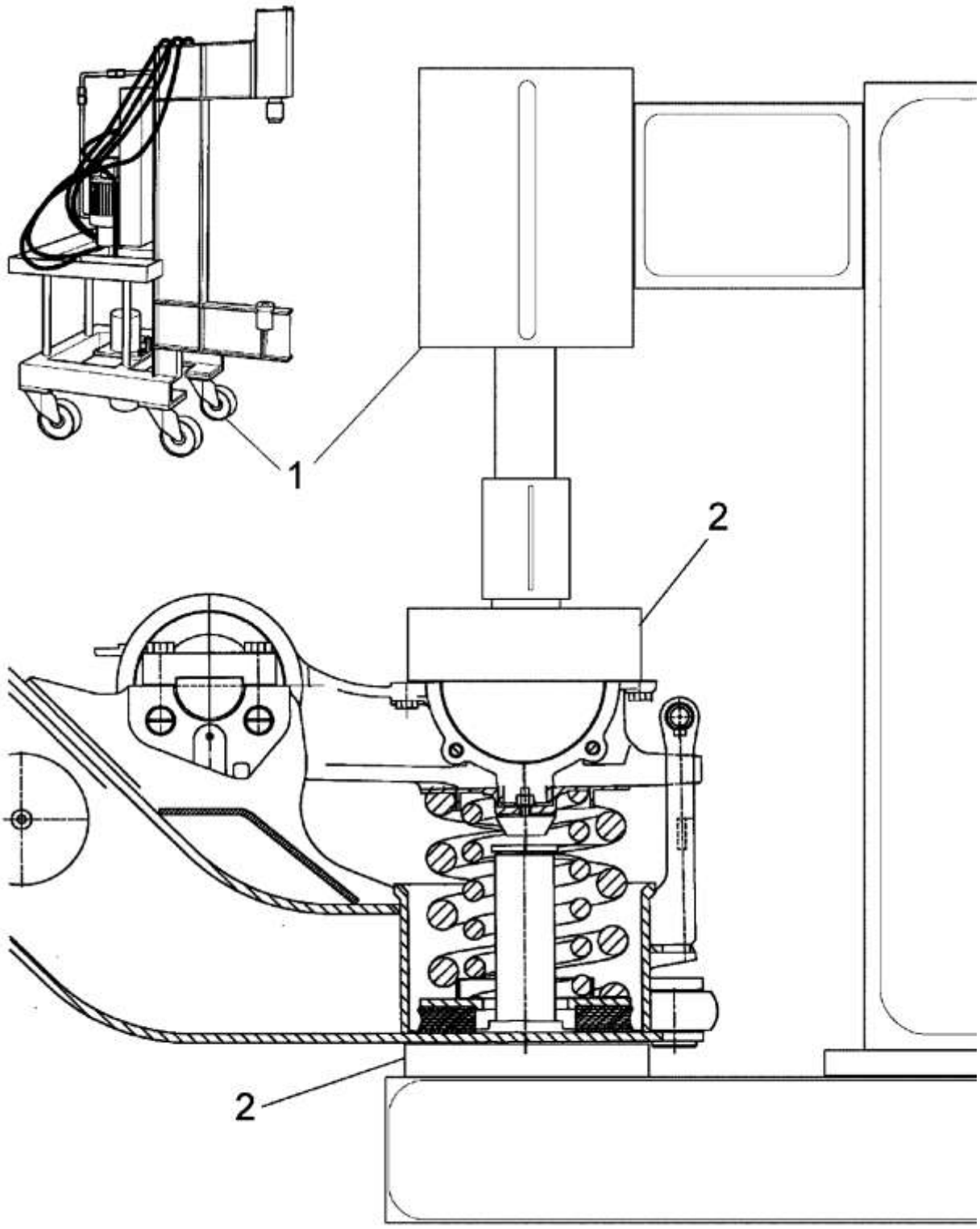


FIG. 3-71 Primary Suspension Assembling



1. Vertical press
2. Wooden block

FIG. 3-72 Pressing The Primary Suspension

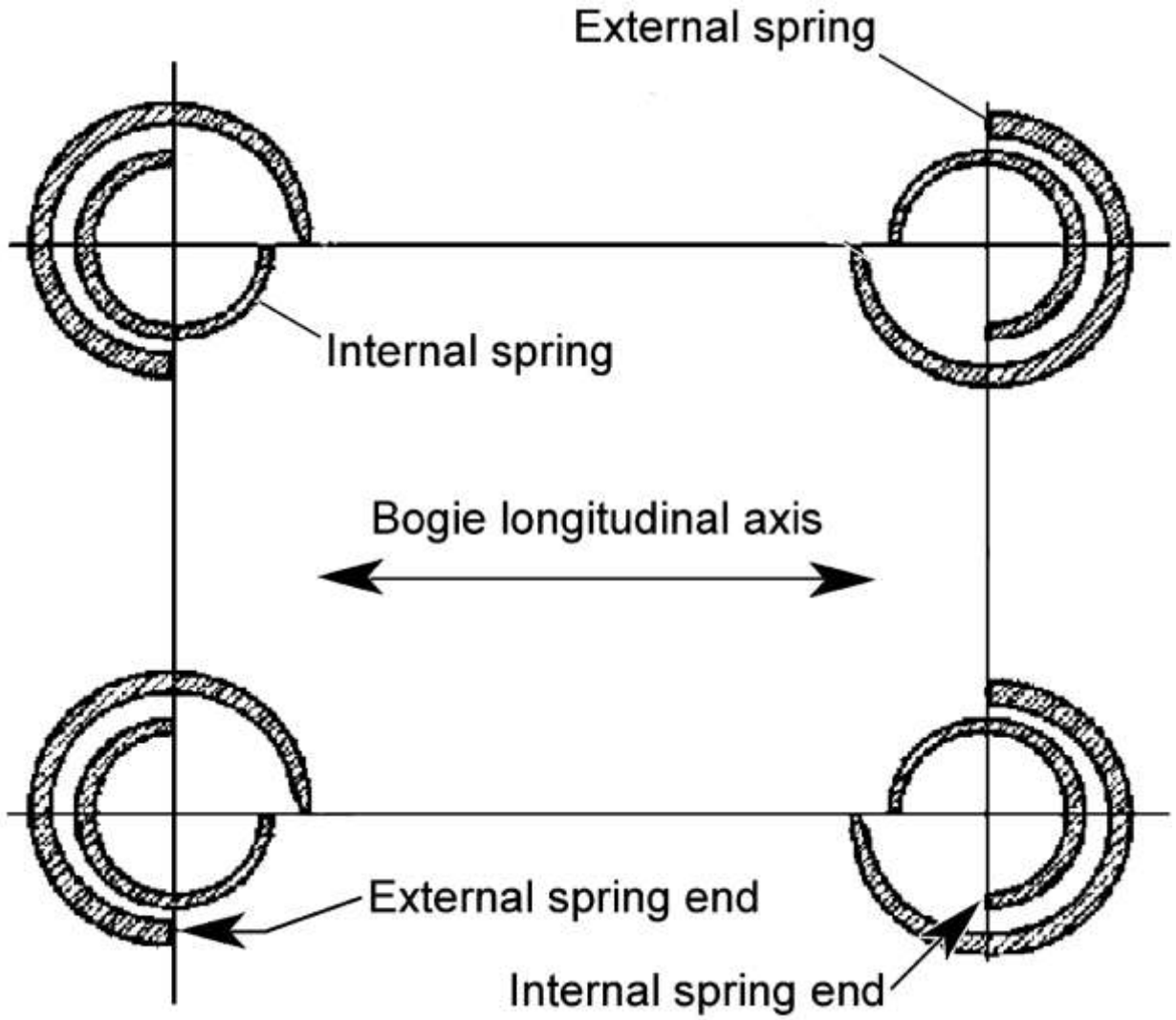


FIG. 4-73 Spring Correct Positioning

After mounting the four primary suspensions, put the bogie again in normal position.

WARNING: PAY ATTENTION WHEN LIFTING THE BOGIE FRAME. UNNECESSARY PEOPLE MUST STAY OUT OF THE LIFTING AREA

4.6.5 Mounting the Ground Cables of the Primary Suspension

Mount the ground cable (1 - FIG. 4-74) between the control arm (2) and the bogie frame (9). Grease the fixing screws and the cable terminals using AGIP GR, API 5 A2. Fix one end of the cable to the bracket (5) and the other to the resistance (8), then link both ends to the control arm (2) by the screw (3) and to the frame (9) by the nut (6).

1. Ground cable
2. Control arm
3. Screw M10x25
4. Washer 10
5. Bracket
6. Nut M10
7. Washer 10
8. Resistance
9. Bogie frame
10. Screw M10x25
11. Washer 10
12. Nut M10
13. Screw M10x16
14. Washer 10

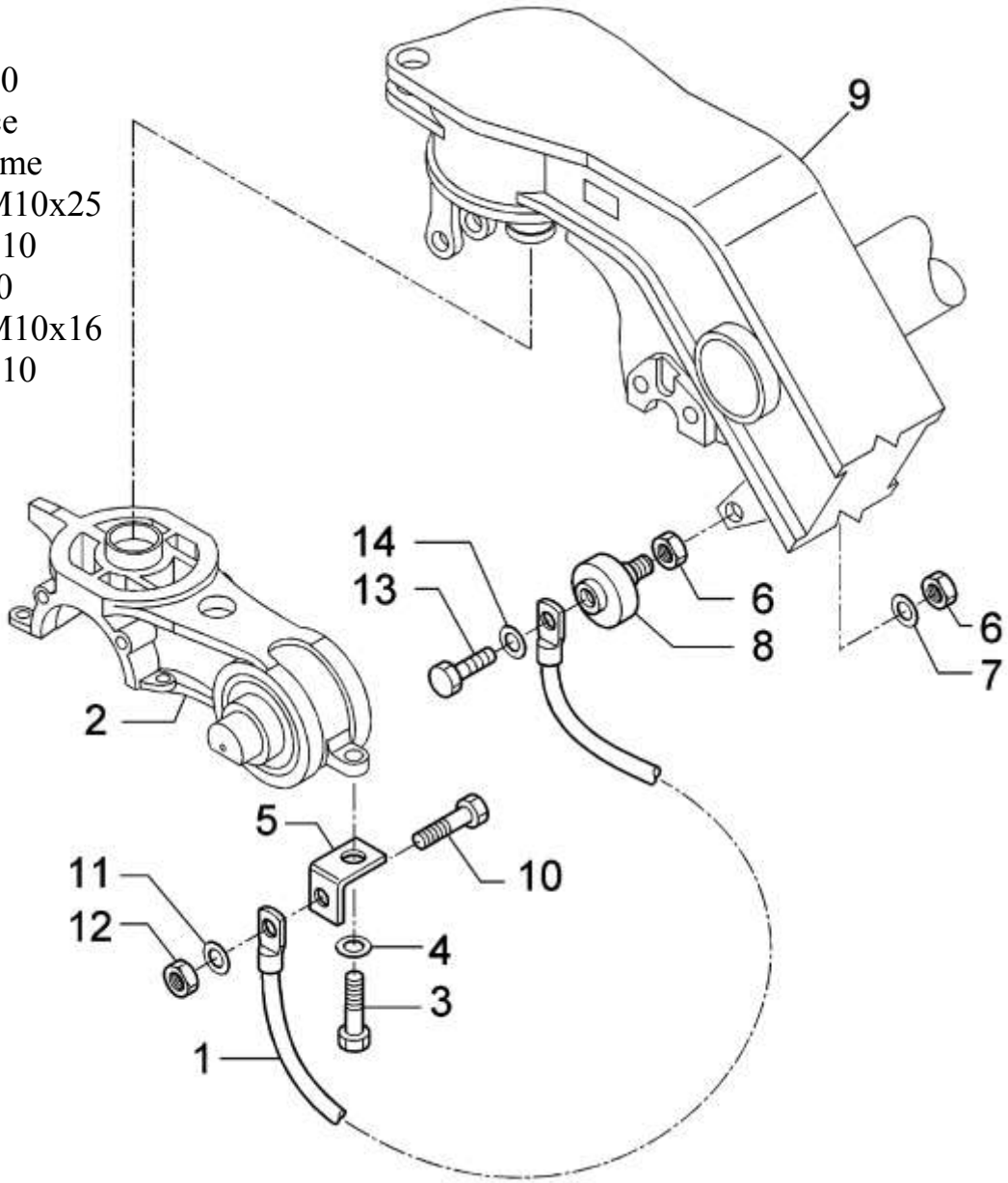
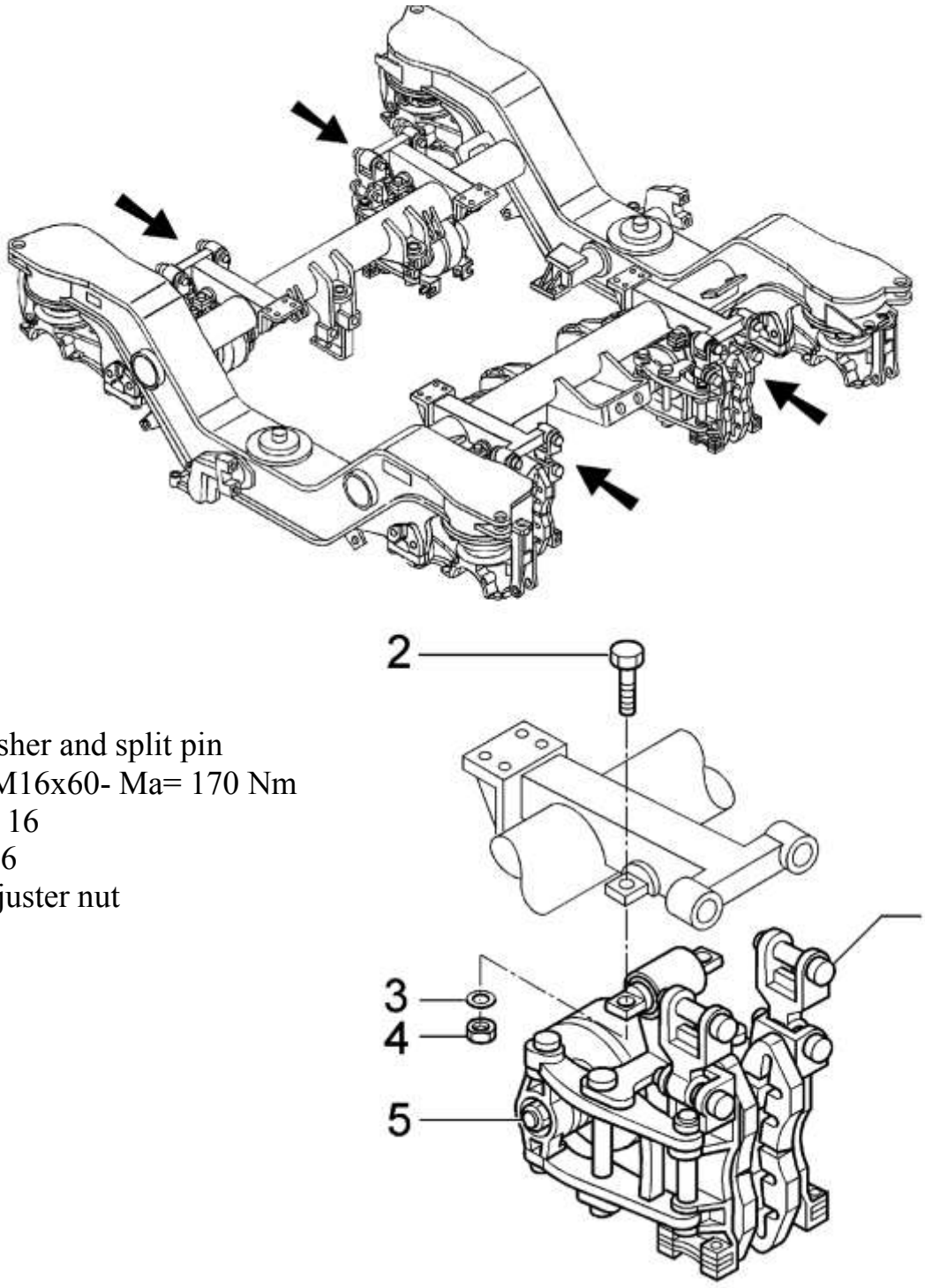


FIG. 3-74 Mounting Ground Cables

4.6.6 Mounting the Brake Groups

Prepare the brake groups to be mounted on the bogies. Pay attention to mount the correct brake units on the right bogies (bogie nr. 1267334 has the hand brakes). Positon the brake units in correspondence of the supports, mount the pin, washer and split pin (1- FIG. 4-75) and then insert and tighten the screws (2), together with the washers (3) and the nuts (4). Turn nut (5) until pad levers are fully open.



1. Pin, washer and split pin
2. Screw M16x60- Ma= 170 Nm
3. Washer 16
4. Nut M16
5. Flac-adjuster nut

FIG. 3-75 Mounting the Brake Groups

4.6.7 Linking the Frame to the Wheel Sets

Before connecting the bogie frame to the wheel sets, perform lubrication of control arm (Fig. 4-76) using „Carebox 0018529" and „Autol Top 2000" lubricants.

NOTE: Do not mix lubricants nor lubricate where unnecessary.

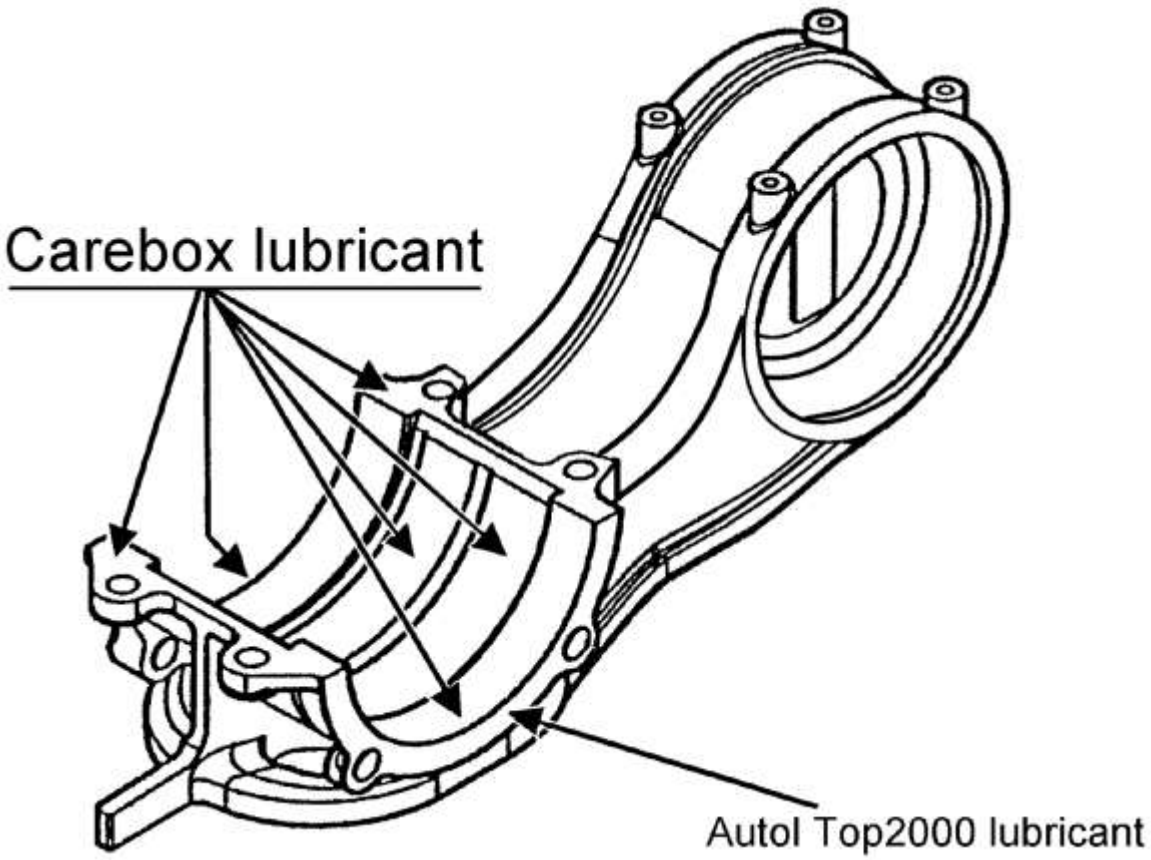
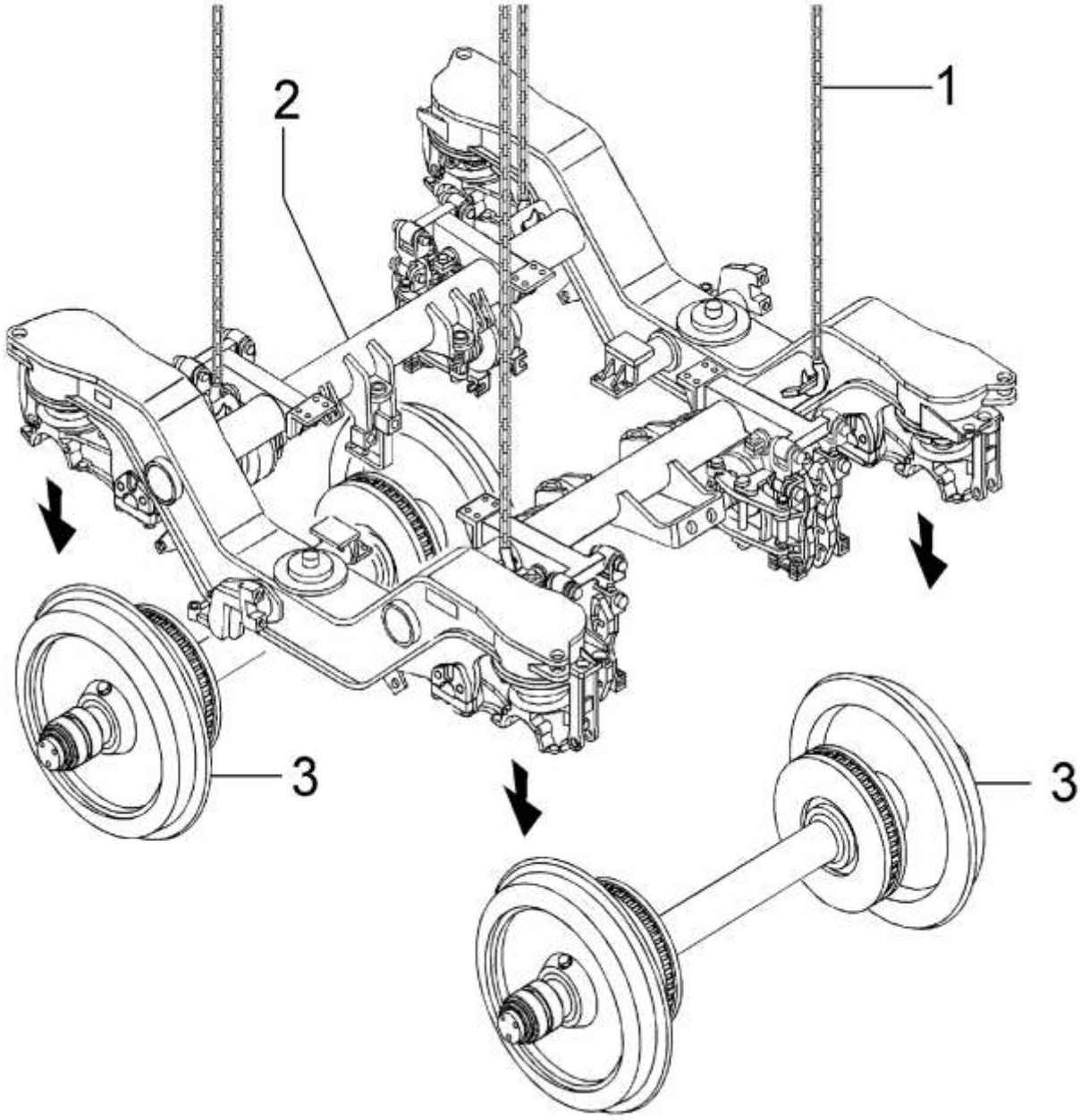


FIG. 3-76 Control Arm Lubrication

Hook the crane equipment (1 - FIG. 4-77) to the bogie frame (2) and lift it with care. Move the frame over the two wheel sets (3 - already complete with their axle bearings) and slowly and carefully lower it.

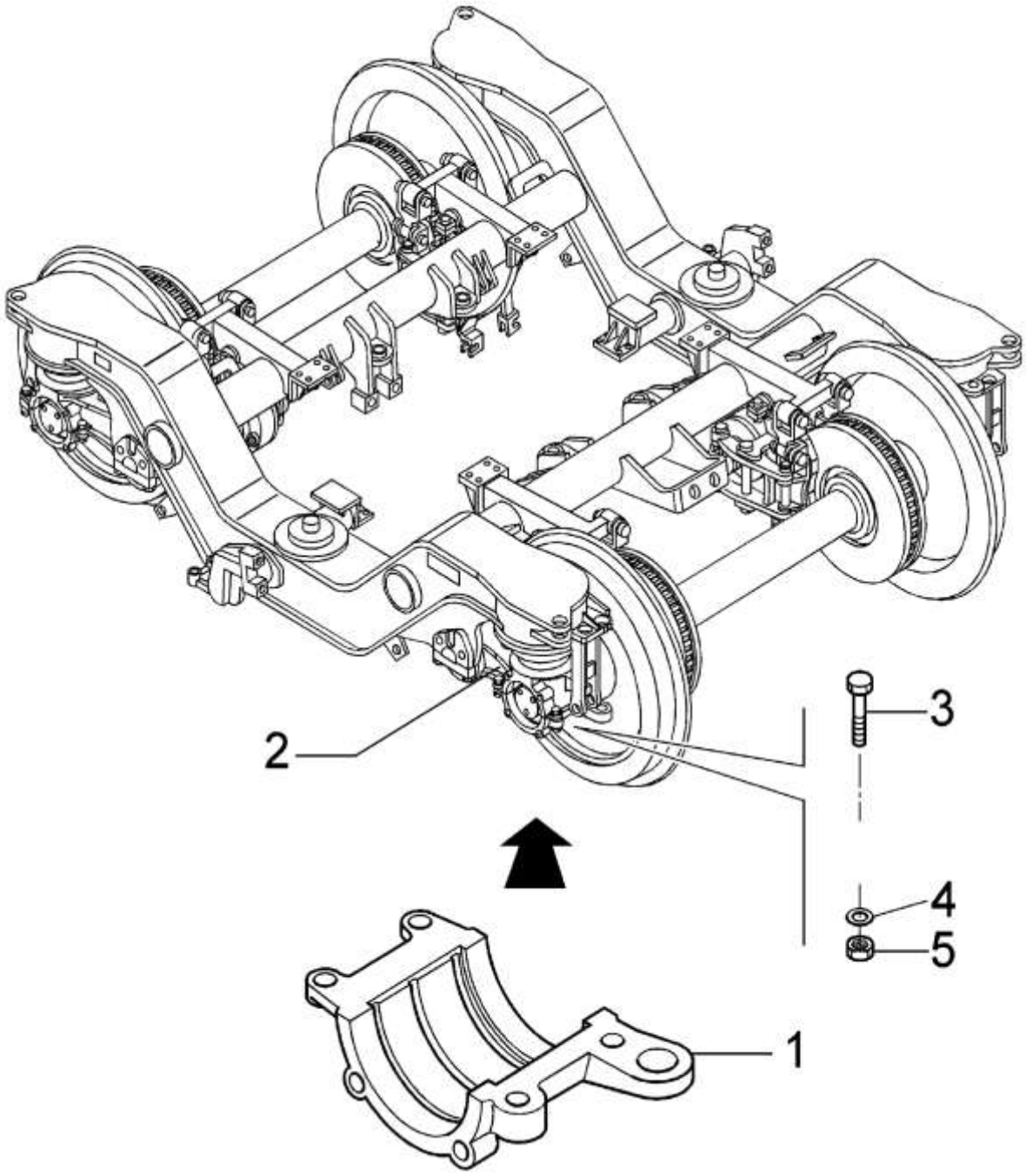
WARNING: TAKE CARE NOT TO DAMAGE THE FRAME, THE WHEELSETS OR TO ENDANGER THE WORKING PERSONNEL NEARBY.



1. Crane equipment
2. Bogie frame
3. Wheel set

FIG. 3-77 Frame Lowering Over the Wheelsets

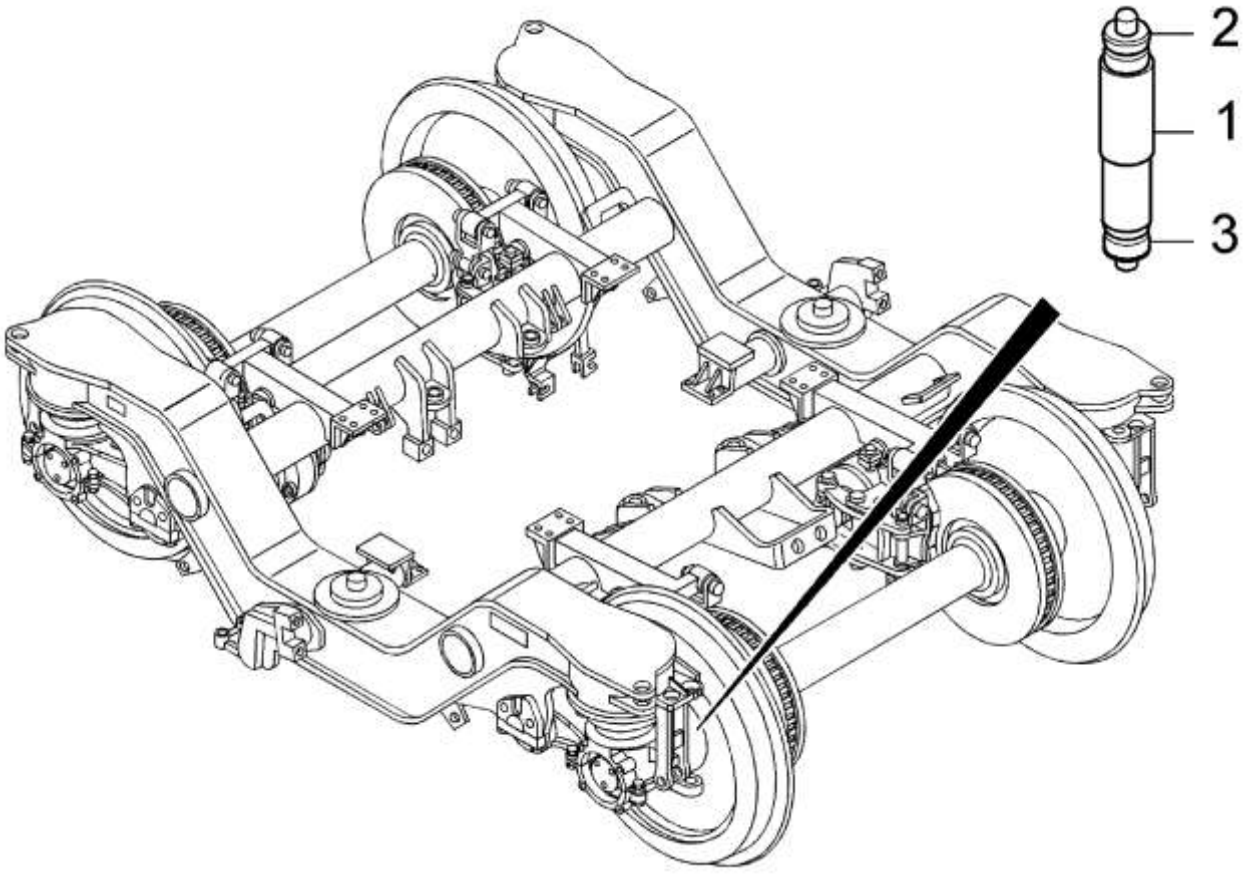
After lowering the frame over the wheelsets, mount the lower parts of the control arms (1 - FIG. 4-78) to the upper one (2): insert the screws (3), the washers (4) and the nuts (5) and tighten them.



1. Control arm lower part
2. Control arm
3. Screw M16x70/ 38 - Ma= 170 Nm
4. Washer 16
5. Nut M16

FIG. 4-78 Mounting the Lower Part of the Control Arms

Mount the four vertical dampers (1 - FIG. 4-79) of the primary suspension, tightening the nuts (2 and 3) at both ends.



1. Vertical damper
2. Nut - Ma= 100 Nm
3. Nut - Ma= 100 Nm

FIG. 3-79 Mounting the Vertical Dampers

4.6.8 Mounting Assemblies on the Frame

4.6.8.1 Mounting Hand Brake Cables (only on bogie1267334)

Fix the two cables (8 - FIG. 4-80) to the frame supports (5) and together using the brackets fixed by the screws (2, 9), washers (3) and nuts (4).

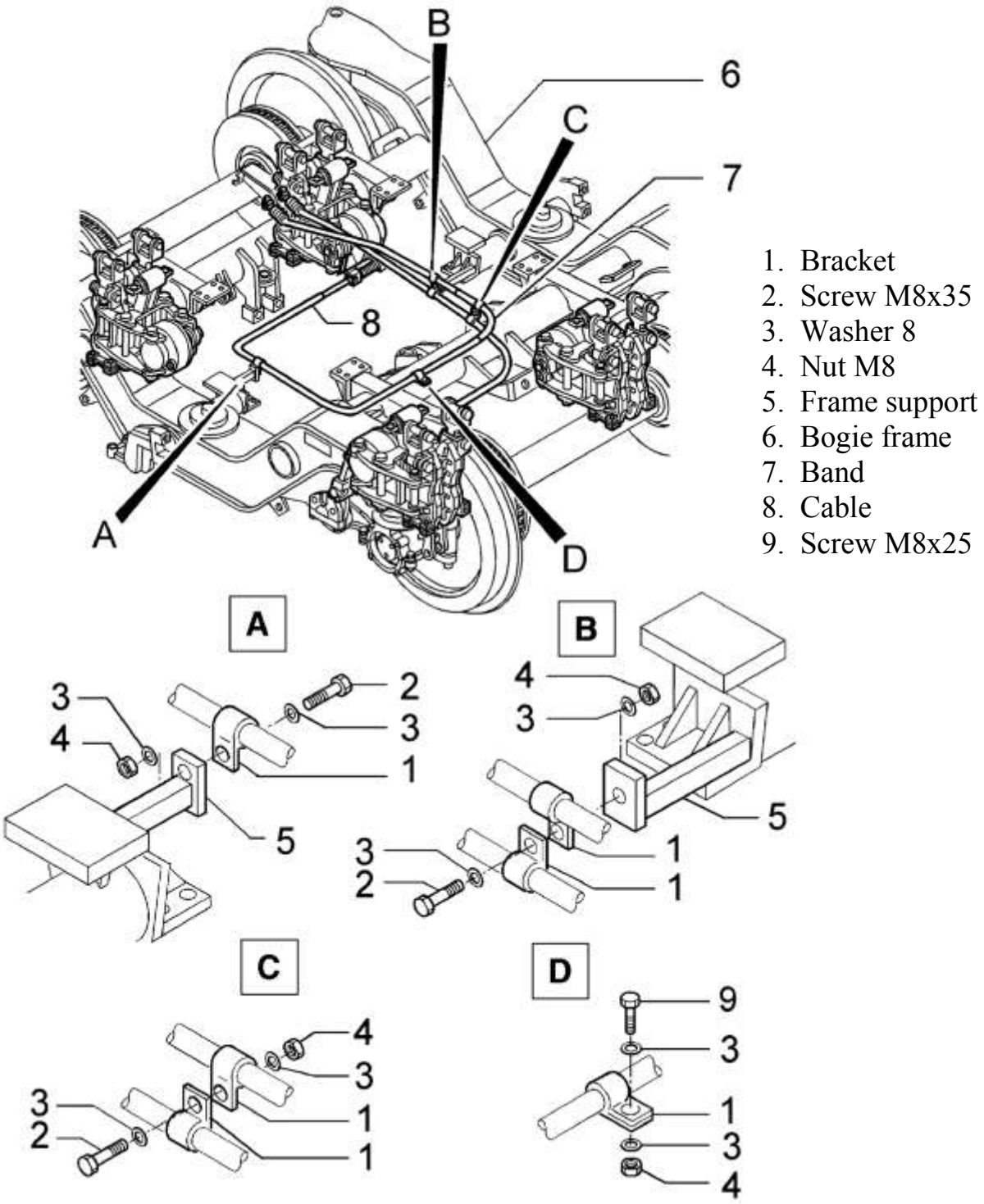
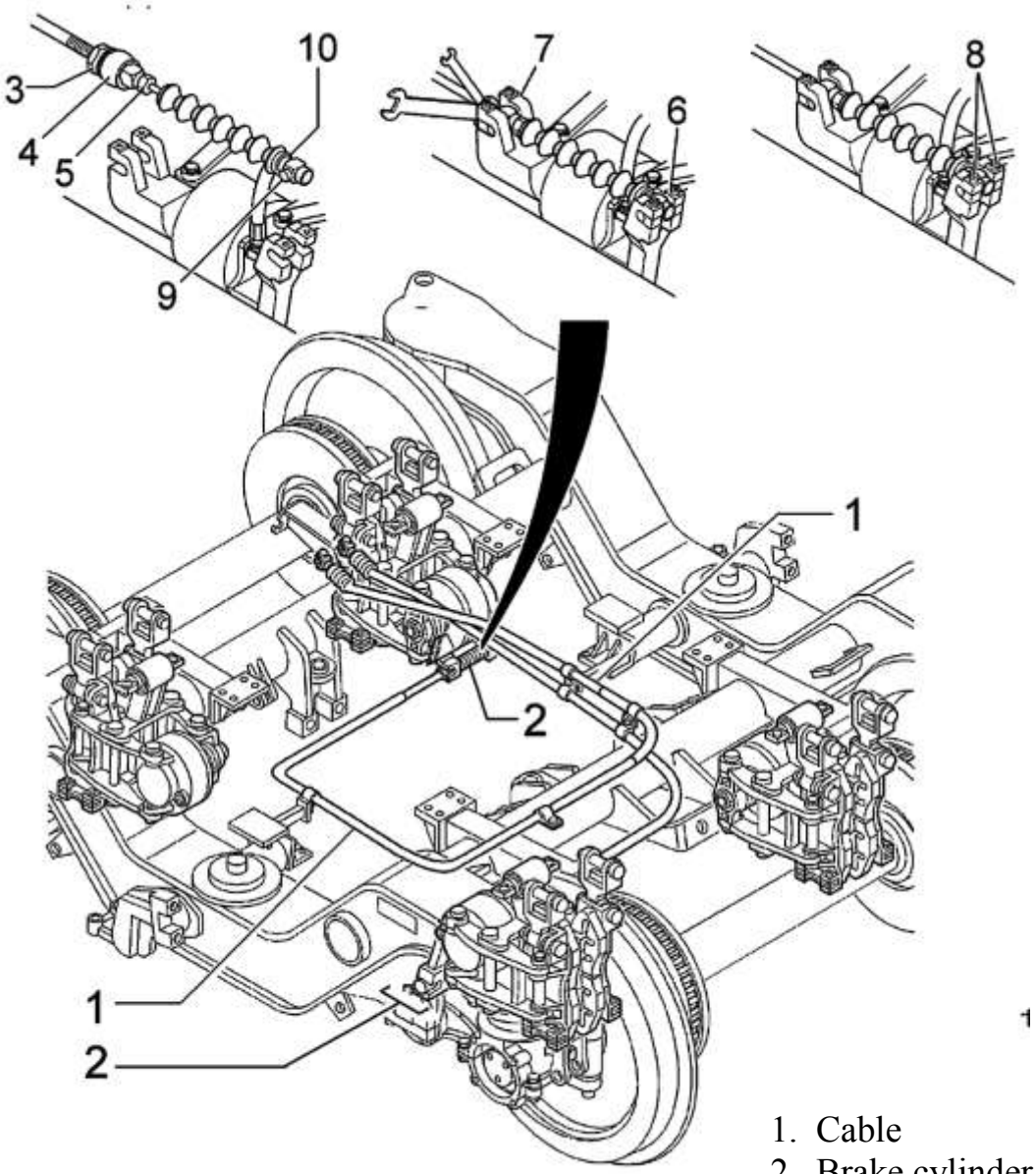


FIG. 3-80 Mounting Hand Brake Cables

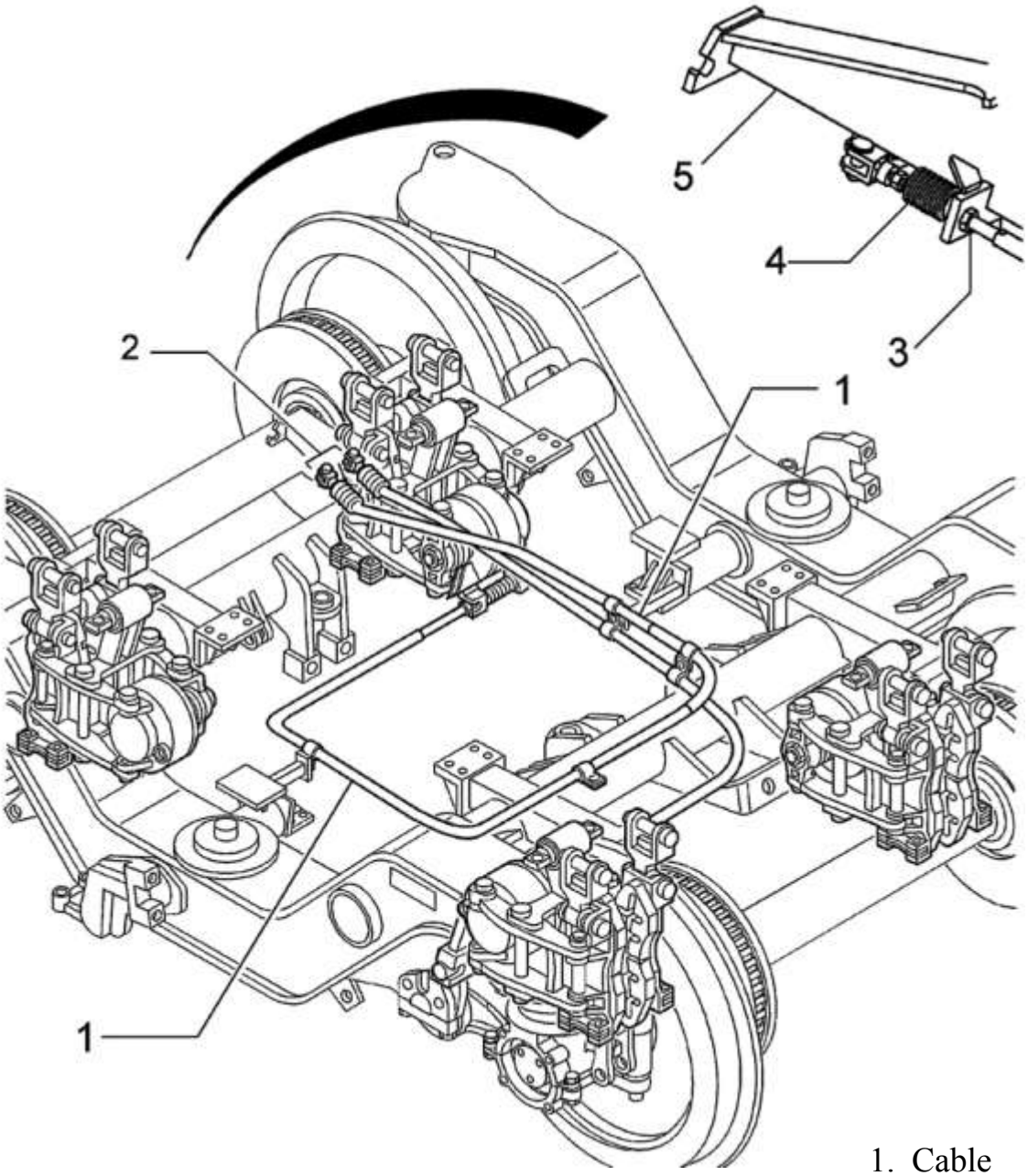
After fixing the cables (1 - FIG. 4-81) to the frame, connect the cable ends (2) to the brake cylinders: loosen the nuts (10) and (5) and insert the end (9) into the fork link (6) and the ball joint (4) into the fork link (7). Tighten the nuts (5) and (10). Rotate the ball joint (4) until it locks. Grease the ball joint (4) using Blasol 135 and tighten the nut (3). Insert and tighten the screws (8).



1. Cable
2. Brake cylinder support
3. Locknut
4. Ball joint
5. Nut
6. Fork link
7. Fork link
8. Screw
9. Cable end
10. Nut

FIG. 3-81 Connecting the Cables to the Brake Cylinders

Put the bellow (4) in position on the support (5). Lock the nut (3).



1. Cable
2. Cable ends
3. Nut
4. Bellow
5. Frame support

FIG. 3-82 Connect the Cables to the Frame Supports

4.6.8.2 Mounting Corner Rolls

Mount the two corner rolls (1 - FIG. 4-83) at the outer corners of the bogie frame: insert the pin (2) and secure it using the washer (3) and the split pin (4)

1. Roll
2. Pin
3. Washer
4. Split pin

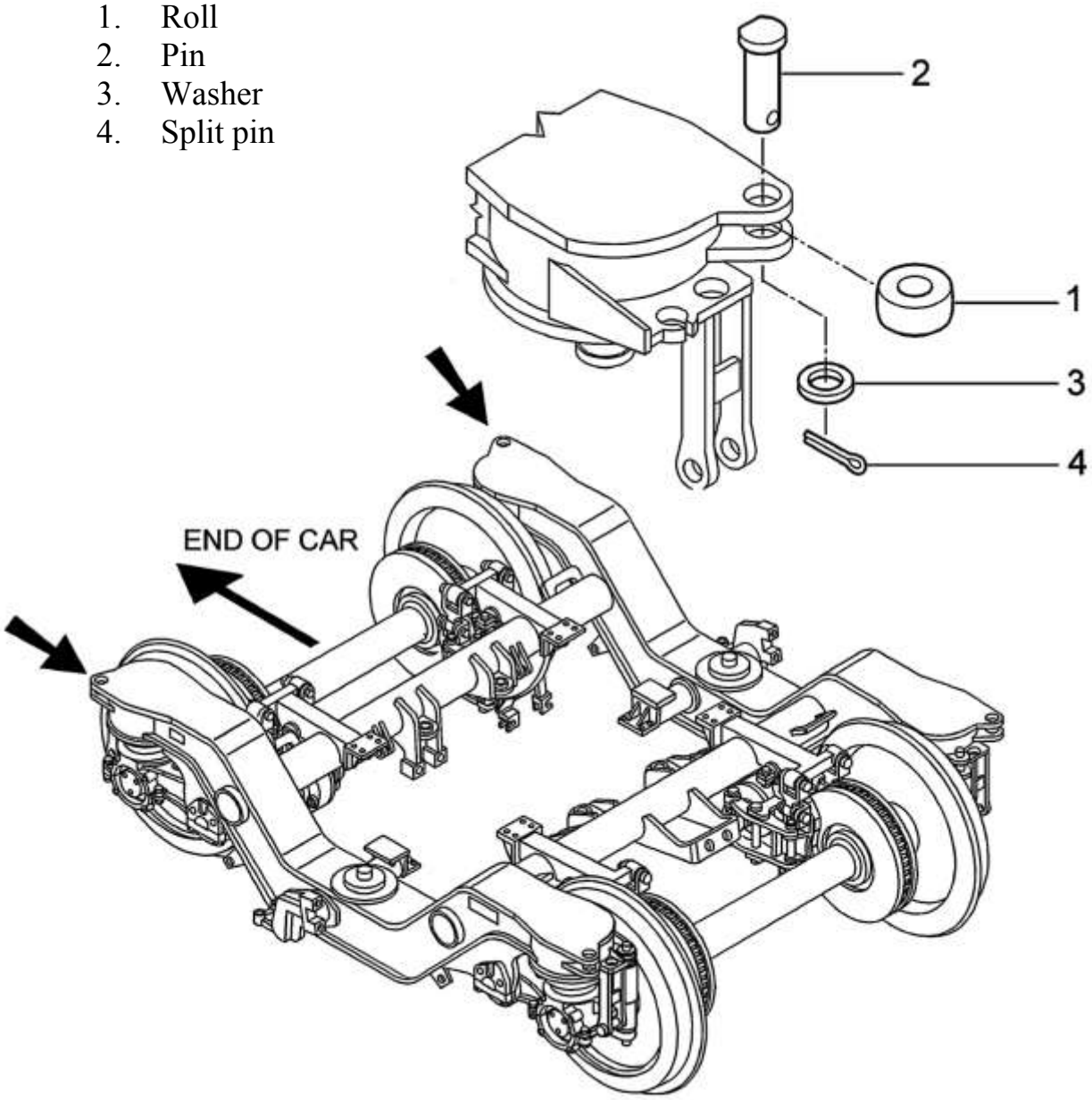


FIG. 3-83 Mounting Corner Rolls

4.6.8.3 Mounting the Pneumatic Equipment

The complete pneumatic equipment for the brakes is made of several pipes (1 - FIG. 4-84) connected together by various types of raccords (2). The final connections between the pipes (1) and the brake cylinders are made by flexible hoses (9).

The pipes are kept into position on the bogie frame (3) by means of brackets (4) fixed to the frame by screws (5 and 8), washers (6) and nuts (7).

For a detail of the raccords, pipes and hoses see the spare parts catalogue.

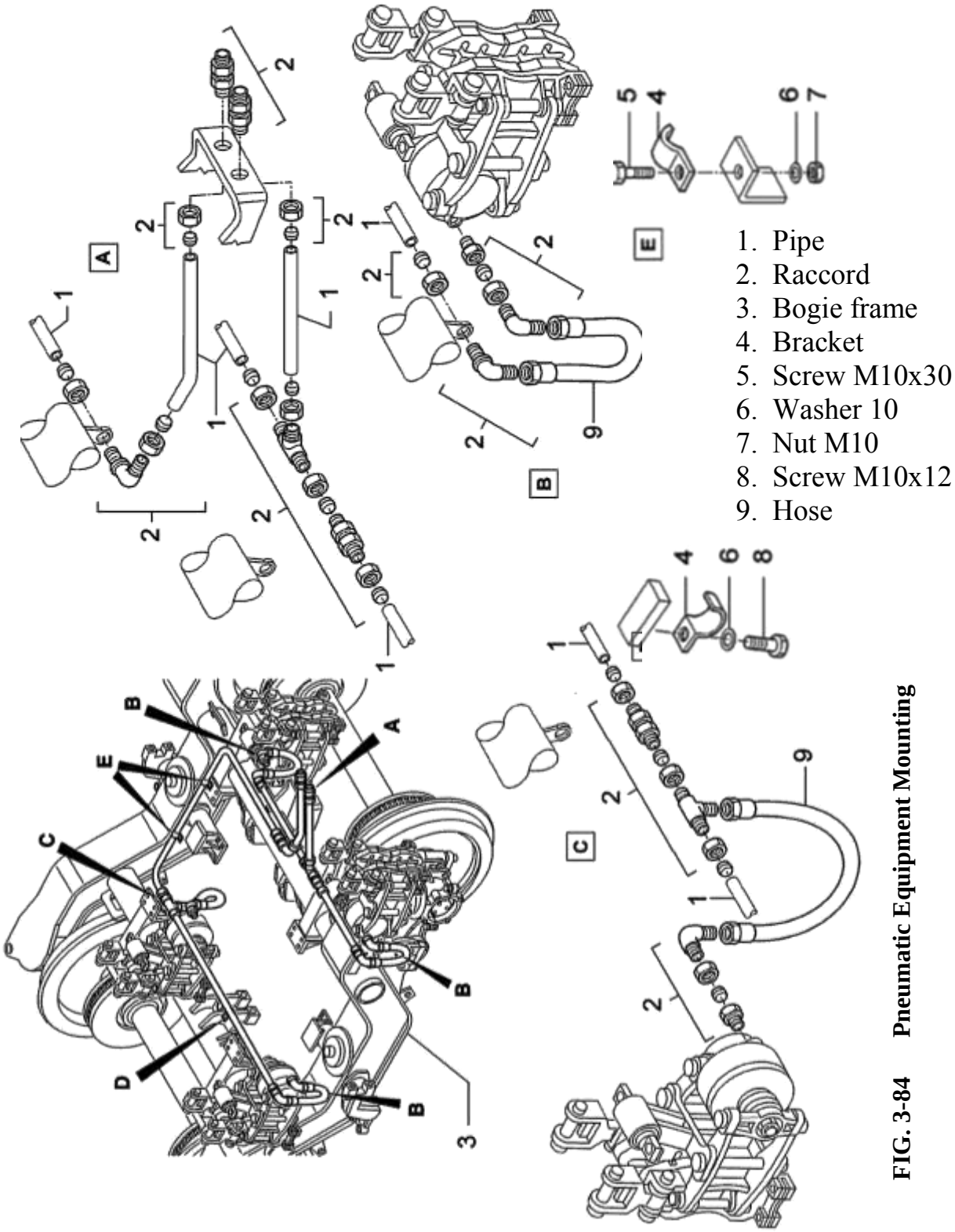


FIG. 3-84 Pneumatic Equipment Mounting

4.6.8.4 Mounting the Traction Centre

In order to mount the traction centre (FIG. 4-85), first assemble the traction lever (6) with the bush (10) and the rods (1). Then connect the free ends of the rods (1) to the bogie frame (2) using the screws (3), the washers (4) and the nuts (5).

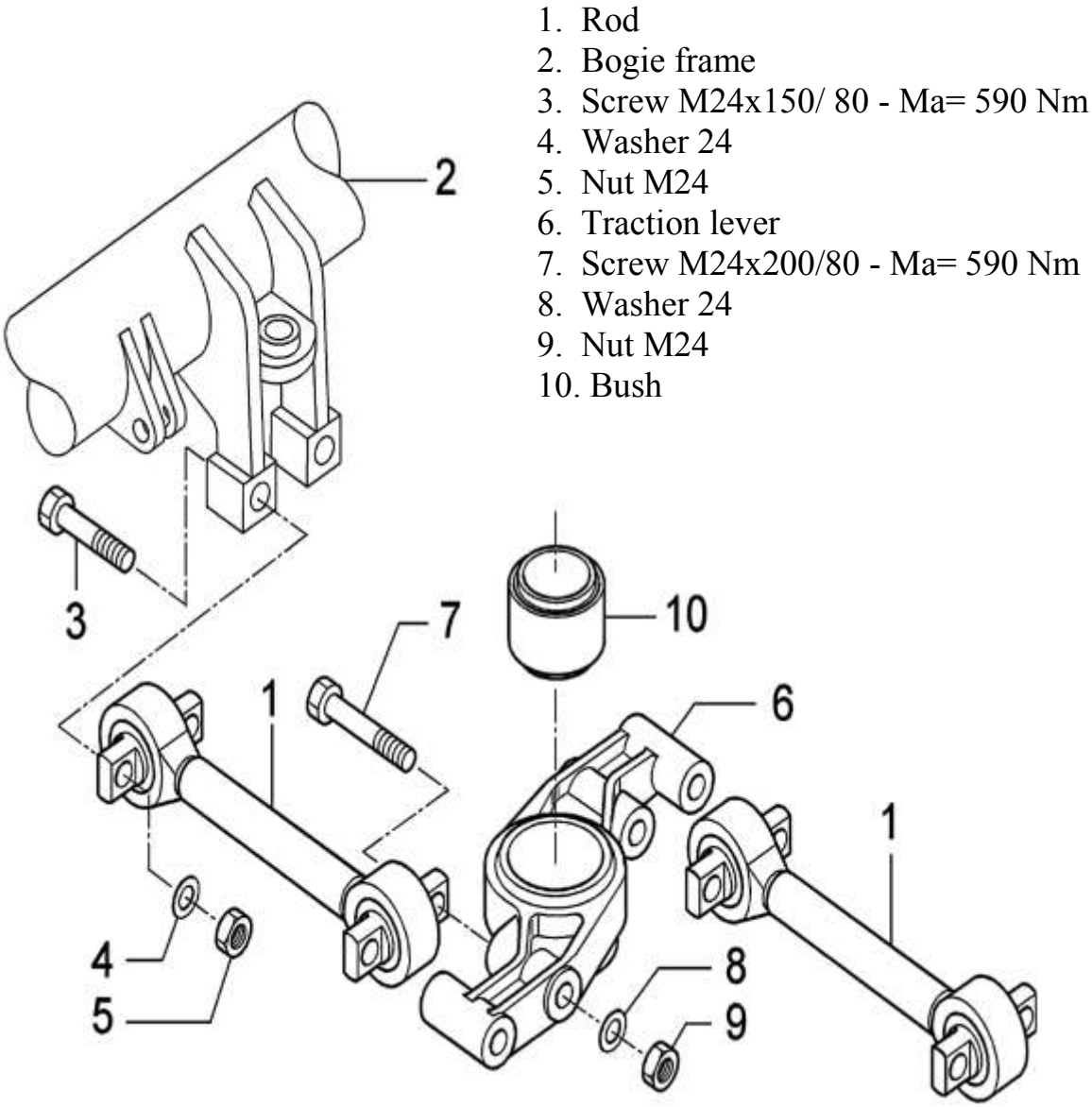
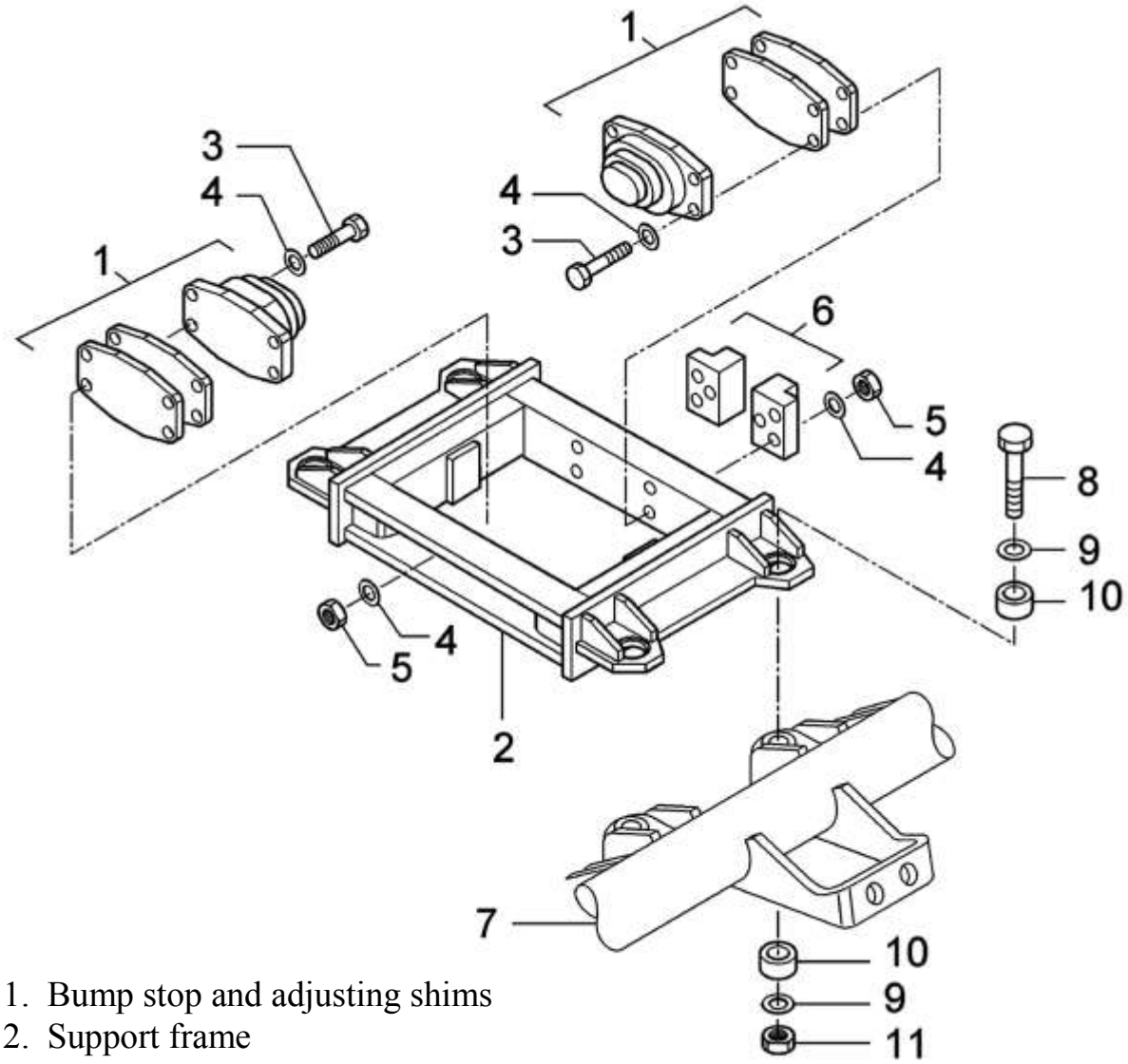


FIG. 3-85 Mounting the Traction Centre

4.6.8.5 Mounting the Lateral Bump Stops

First mount the bump stops and the shims (1 - FIG. 4-86) on the support frame (2) using the screws (3), the washers (4) and the nuts (5). On one side of the frame (2) mount the supports (6) for the lateral damper. Then mount the support frame on the bogie using the screws (8), the washers (9), the discs (10) and the nuts (11).

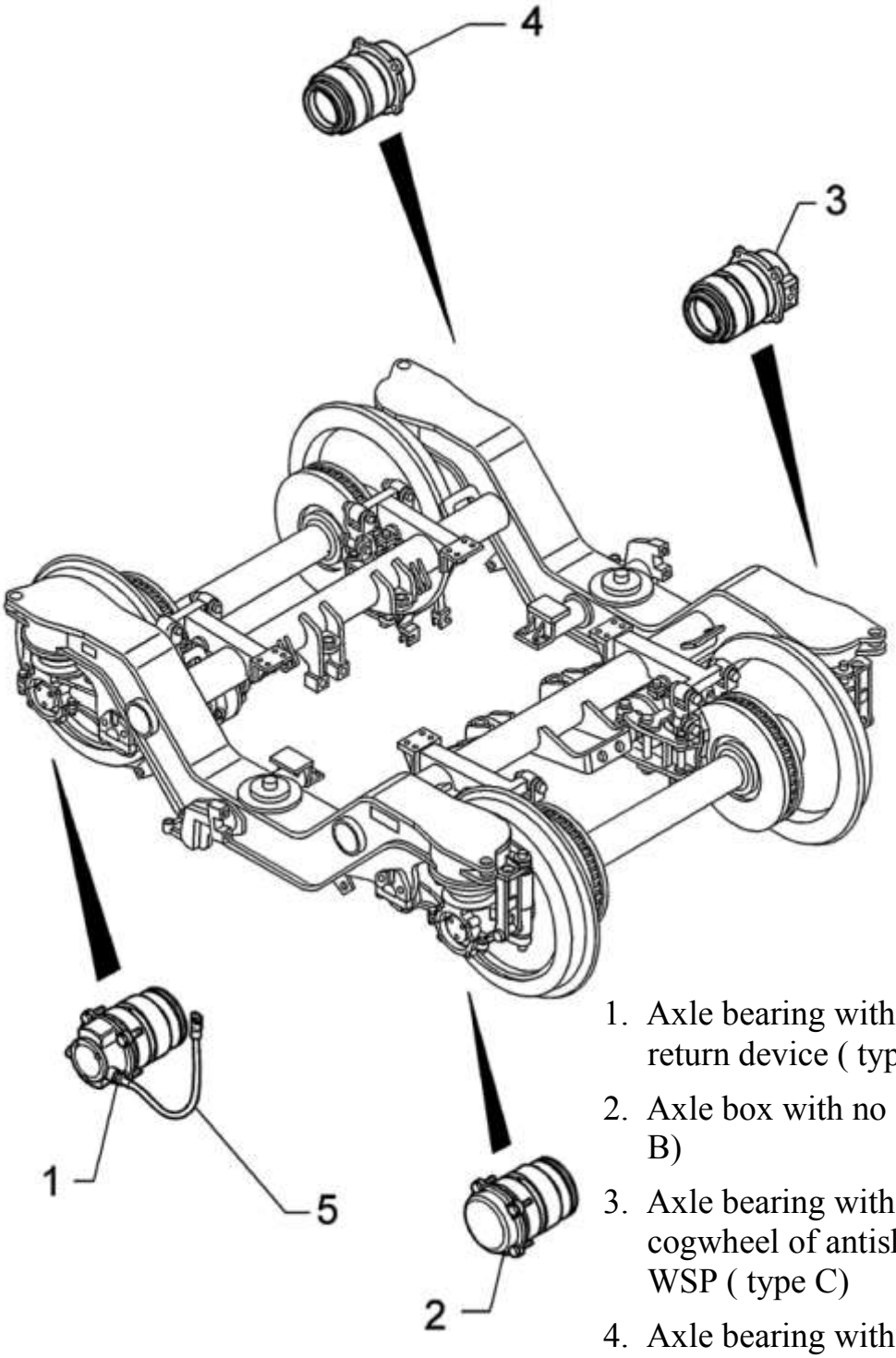


1. Bump stop and adjusting shims
2. Support frame
3. Screw M16x100 - Ma= 170 Nm
4. Washer 16
5. Nut M16
6. Lateral damper support
7. Bogie frame
8. Screw M20x100/ 46 - Ma= 340 Nm
9. Washer 20
10. Disc
11. Nut M20

FIG. 3-86 Mounting the Lateral Bump Stops

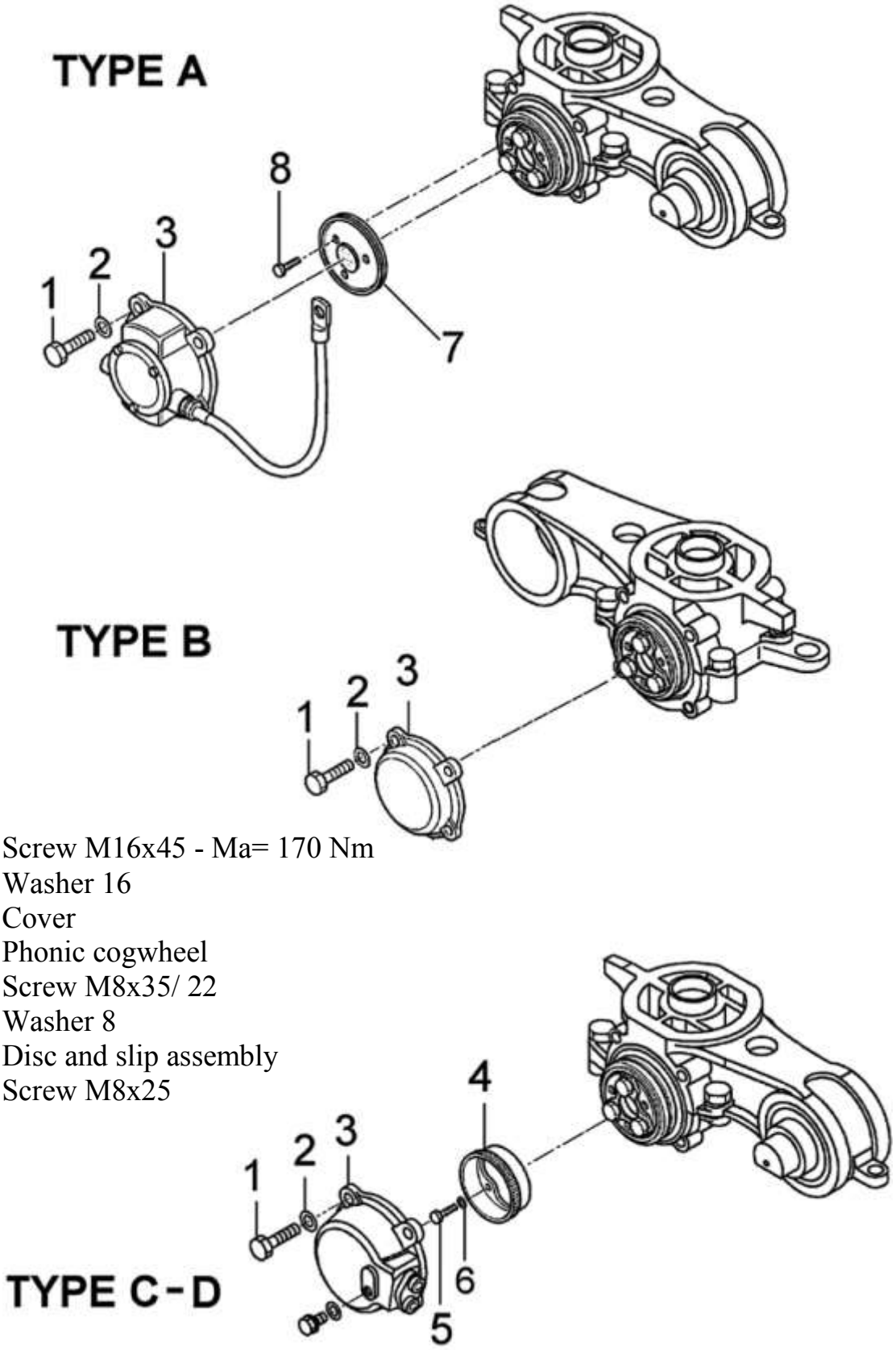
4.6.9 Mounting the Axle Bearing Equipments

Assemble the four different types of equipments (Type A, B, C and D) according to the disposition shown in FIG. 4-87. Tighten the screws at the prescribed torques.



1. Axle bearing with current return device (type A)
2. Axle box with no sensor (type B)
3. Axle bearing with phonic cogwheel of antiskid sensor WSP (type C)
4. Axle bearing with phonic cogwheel of antiskid sensor WSP (type D)
5. Earth cable

FIG. 3-87 Axle Bearing Equipment Disposition

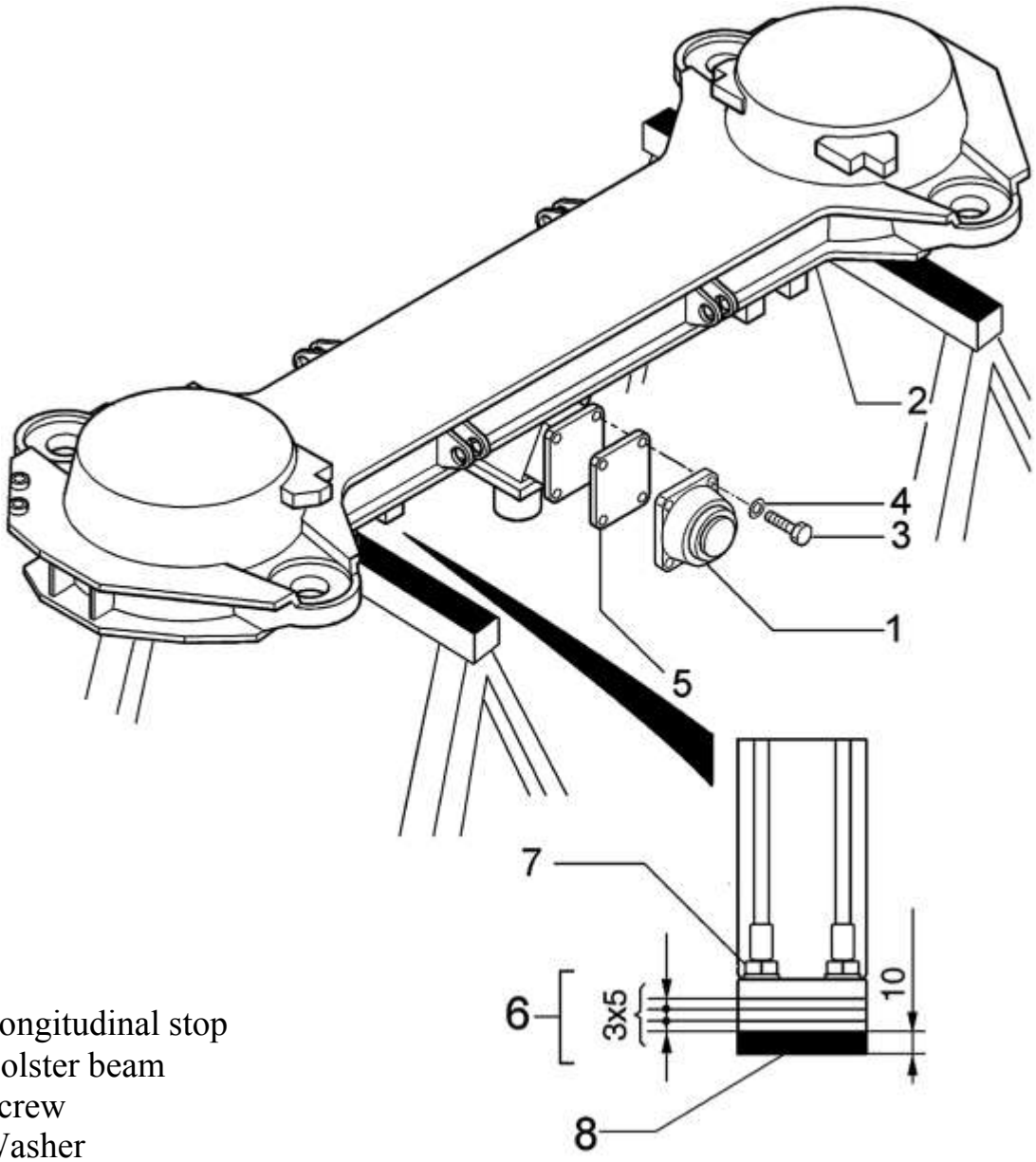


1. Screw M16x45 - Ma= 170 Nm
2. Washer 16
3. Cover
4. Phonic cogwheel
5. Screw M8x35/ 22
6. Washer 8
7. Disc and slip assembly
8. Screw M8x25

FIG. 3-88 Axle Bearing Equipment Assembling

4.6.10 Assembling the Bolster Beam

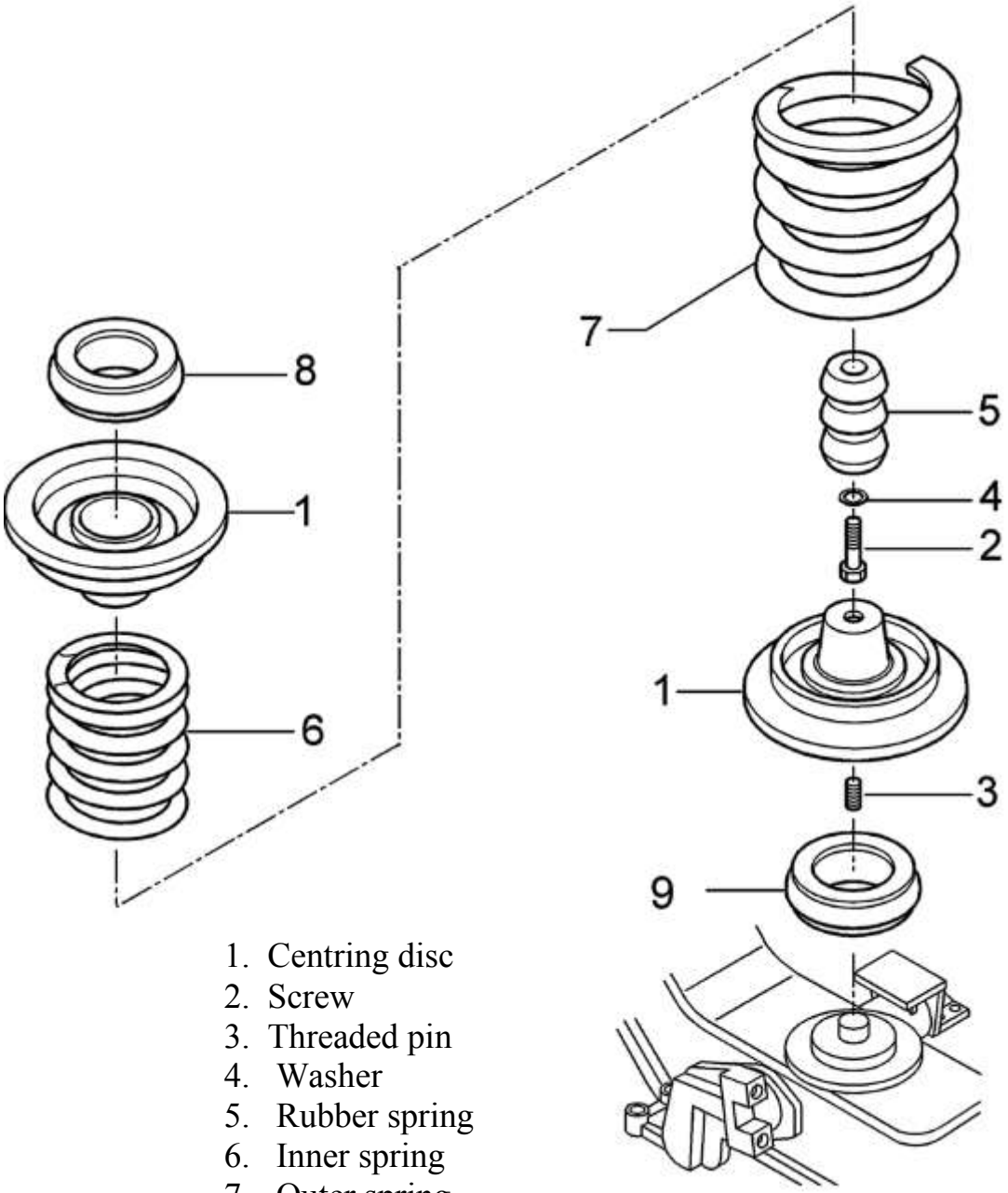
Proceed with screwing the longitudinal bump stops (1- FIG. 4-89) and the shim (5) on the bolster beam (2). Mount the three 5 mm metal shims (6) and the 10 mm synthetic one (8) under the bolster beam (2).



1. Longitudinal stop
2. Bolster beam
3. Screw
4. Washer
5. Shim
6. Shims
7. Screw M8x50, nut M8 and washer 8
8. Wear plate

FIG. 3-89 Mounting Bump Stops On the Bolster Beam

Assemble the spring packs (FIG. 4-90) on the bogie frame: preassemble the rubber spring (5) with the upper centring disc (1) using the screw (2) and the washer (4). Preassemble the threaded pin (3) and the lower centring disc (1). Secure both the screw and the threaded pin (3) using LOCTITE 243. Put the lower MINER pad (9) on the frame seat and mount over it the lower disc assembly (1+3), the inner (6) and outer springs (7), the upper disc assembly (1+2+4+5) and, finally, the upper MINER pad (8). When mounting old springs respect original location and mutual position as marked during dismounting.



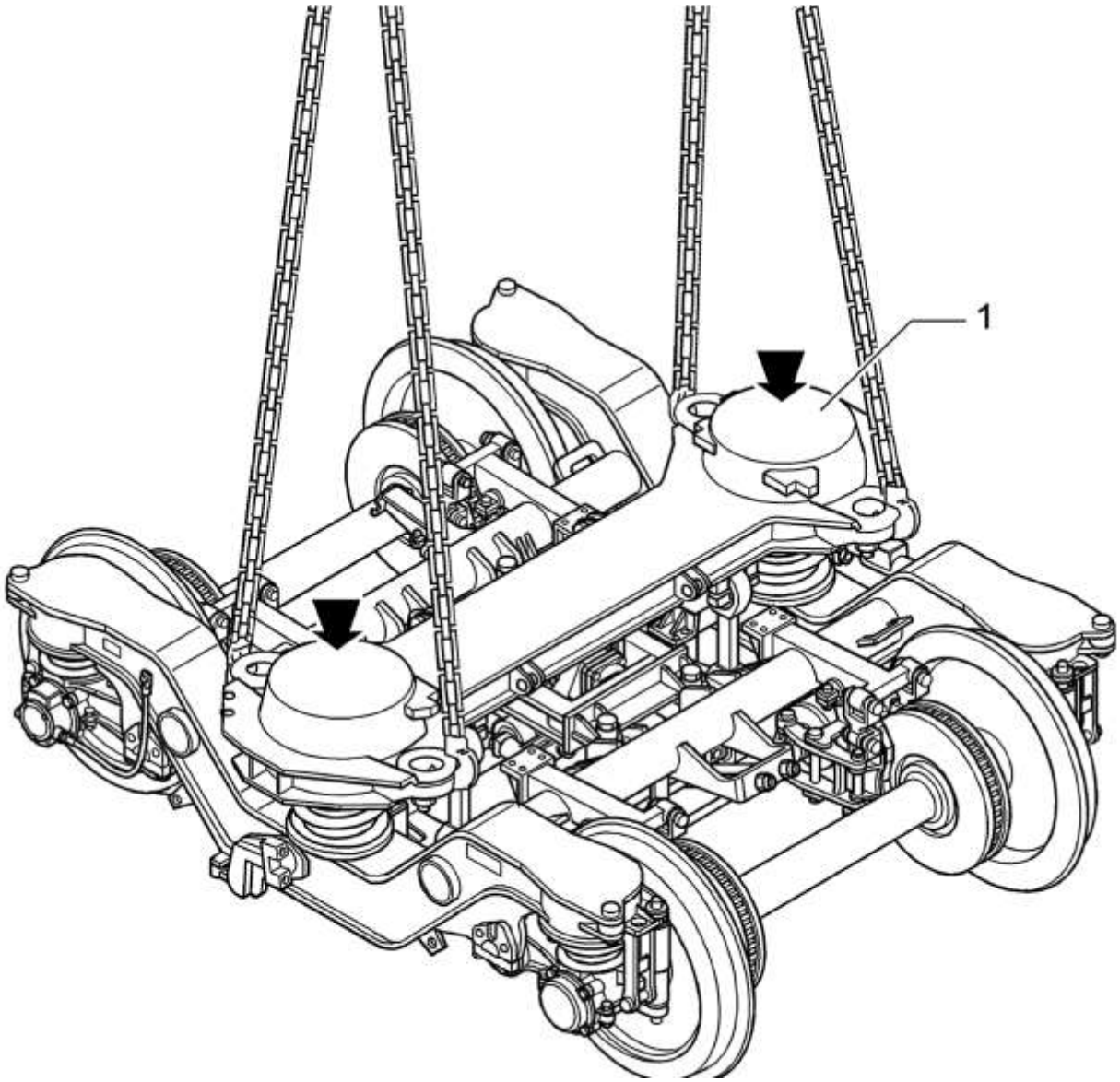
1. Centring disc
2. Screw
3. Threaded pin
4. Washer
5. Rubber spring
6. Inner spring
7. Outer spring
8. MINER pad
9. MINER pad

FIG. 3-90 Assembling the Spring Pack

It is now possible to lift the bolster beam (1 - FIG. 4-91) and to position it over the spring packs on the bogie frame.

WARNING: PAY ATTENTION WHEN LIFTING THE BOLSTER BEAM IN ORDER TO AVOID ANY INJURY TO PERSONNEL, ANY PEOPLE NOT INVOLVED IN THE OPERATION MUST STAY AWAY FROM THE WORKING AREA. TAKE CARE NOT TO DAMAGE THE BOLSTER BEAM SURFACE WHEN OPERATING

Link the crane equipment to the bolster beam (1) and begin lifting it with care. Move it over the bogie frame and then lower it with care, paying attention to correctly insert the central pin into the traction centre bush.



1. Bolster beam

FIG. 3-91 Positioning the Bolster Beam over the Bogie Frame

4.6.11 Pressing the Bolster Beam

The mounting of the safety cables , the connection of the bolster beam to the traction centre and to the anti-roll bar requires the use of the press 12.613.0376 (1 - FIG. 4-92). The press is secured to the brake support beam (3) through the hooks (2). On its top the press has a small compressor which operates two actuators.

Before pressing the bolster beam, put a wooden cube block (135 mm side) under the actuators. Operate the compressor and press the bolster beam. It is necessary to press until the rubber spring of the secondary suspension touches the lower disc.

1. Bolster beam press
2. Hook
3. Brake support beam
4. Compressor

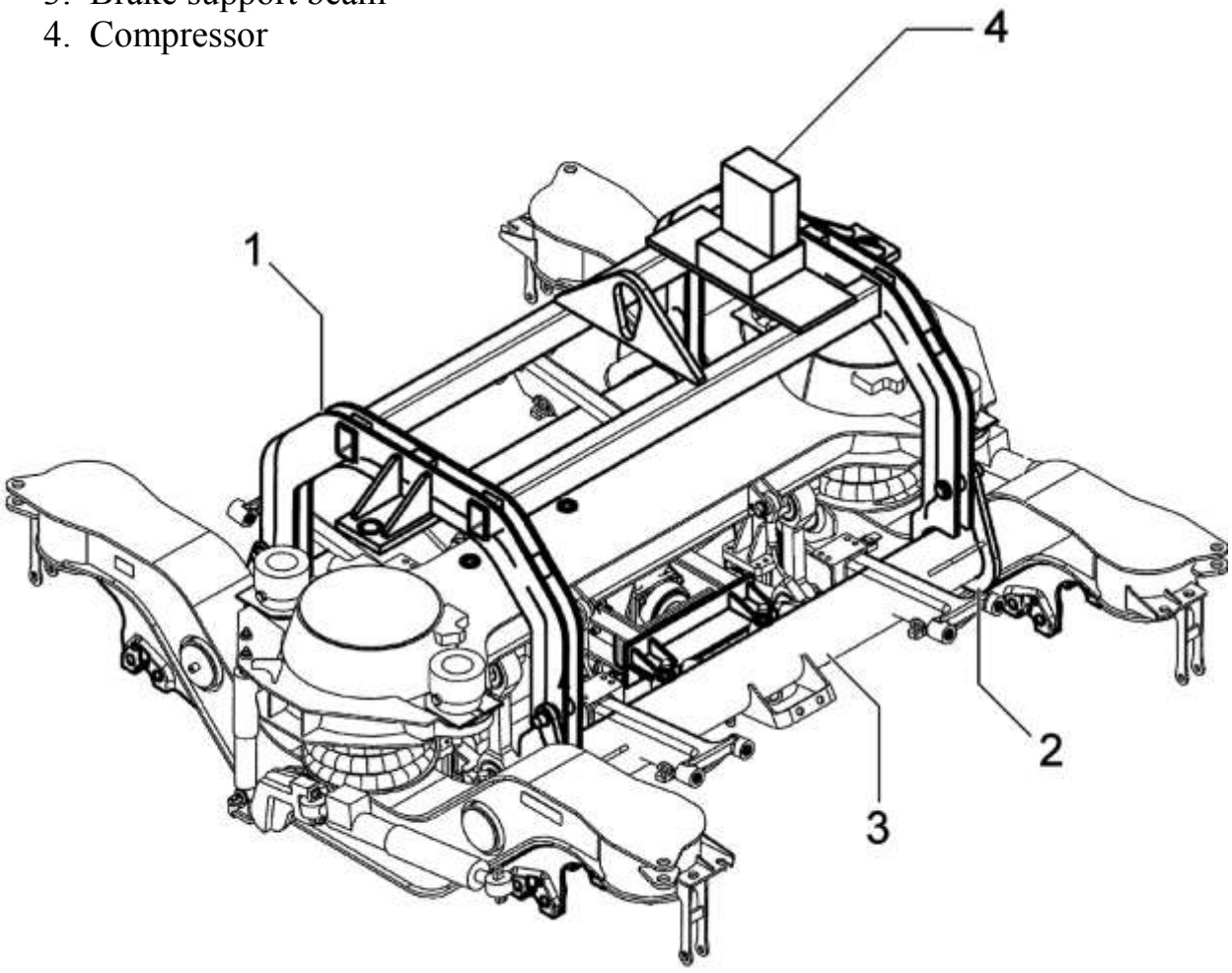


FIG. 3-92 Pressing the Bolster Beam

4.6.12 Mounting Safety Cables

After pressing the bolster beam, mount the four safety cables (1 - FIG. 4-93) which link the bolster beam to the bogie frame: insert the pins (3) and the washers (4), then secure them by the safety pins at both ends.

1. Safety cable
2. Safety pin
3. Pin
4. Washer

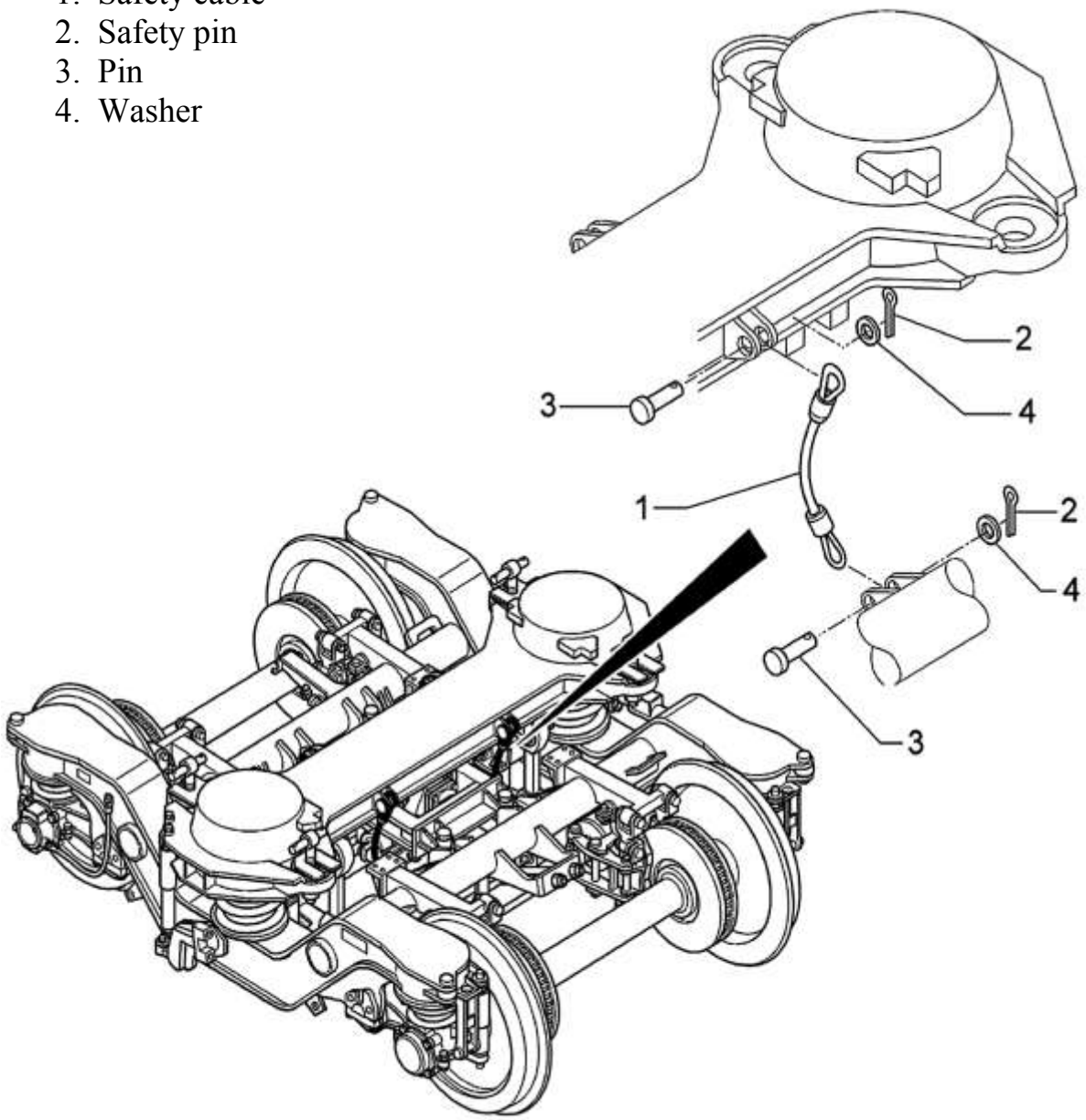
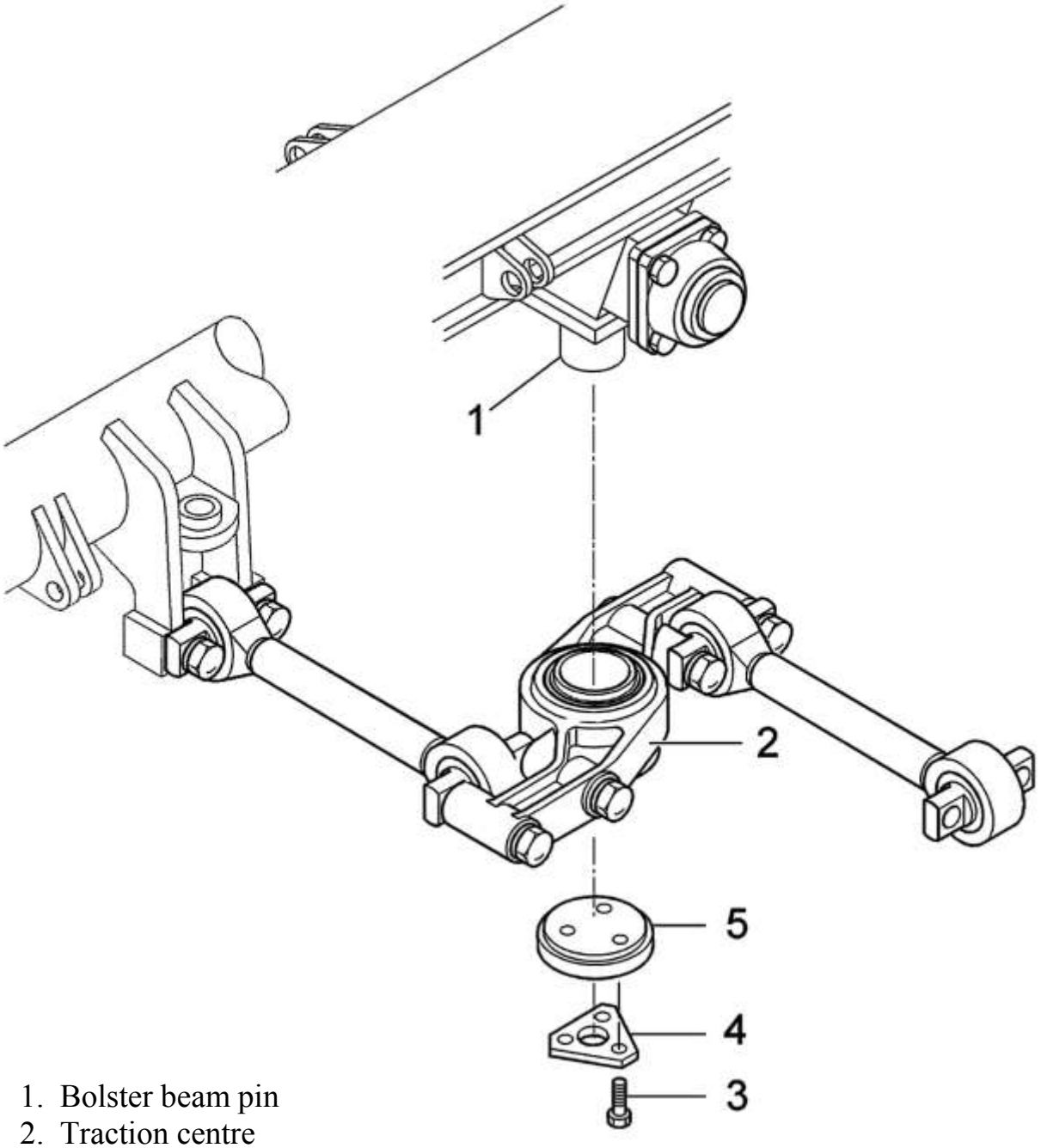


FIG. 3-93 Mounting Safety Cables

4.6.13 Connect Bolster Beam to Traction Centre

After pressing the bolster beam as described earlier, fix the central pin (1 - FIG. 4-94) to the traction centre (2) by means of the disc (5), the plate (4) and the screw (3).



1. Bolster beam pin
2. Traction centre
3. Screw M16x70/ 38 - Ma= 170 Nm
4. Plate
5. Disc

FIG. 3-94 Connecting Bolster Beam to Traction Centre

4.6.14 Mounting the Anti-Roll Bar

The anti-roll bar (1- FIG. 4-95) must be connected to bogie frame supports (3) using the screws (6) and the washers (8) on the brackets (7). The anti-roll bar links (5) must be connected to the bolster beam (2) using the screws (4). This operation is performed after putting the whole bogie under a press in order to simulate the tare load conditions.

1. Anti- roll bar
2. Bolster beam
3. Frame support
4. Screw M24x100 – Ma = 590 Nm
5. Anti-roll bar link
6. Screw M16x160/ 44 - Ma= 170 Nm
7. Anti- roll bar bracket
8. Washer 16

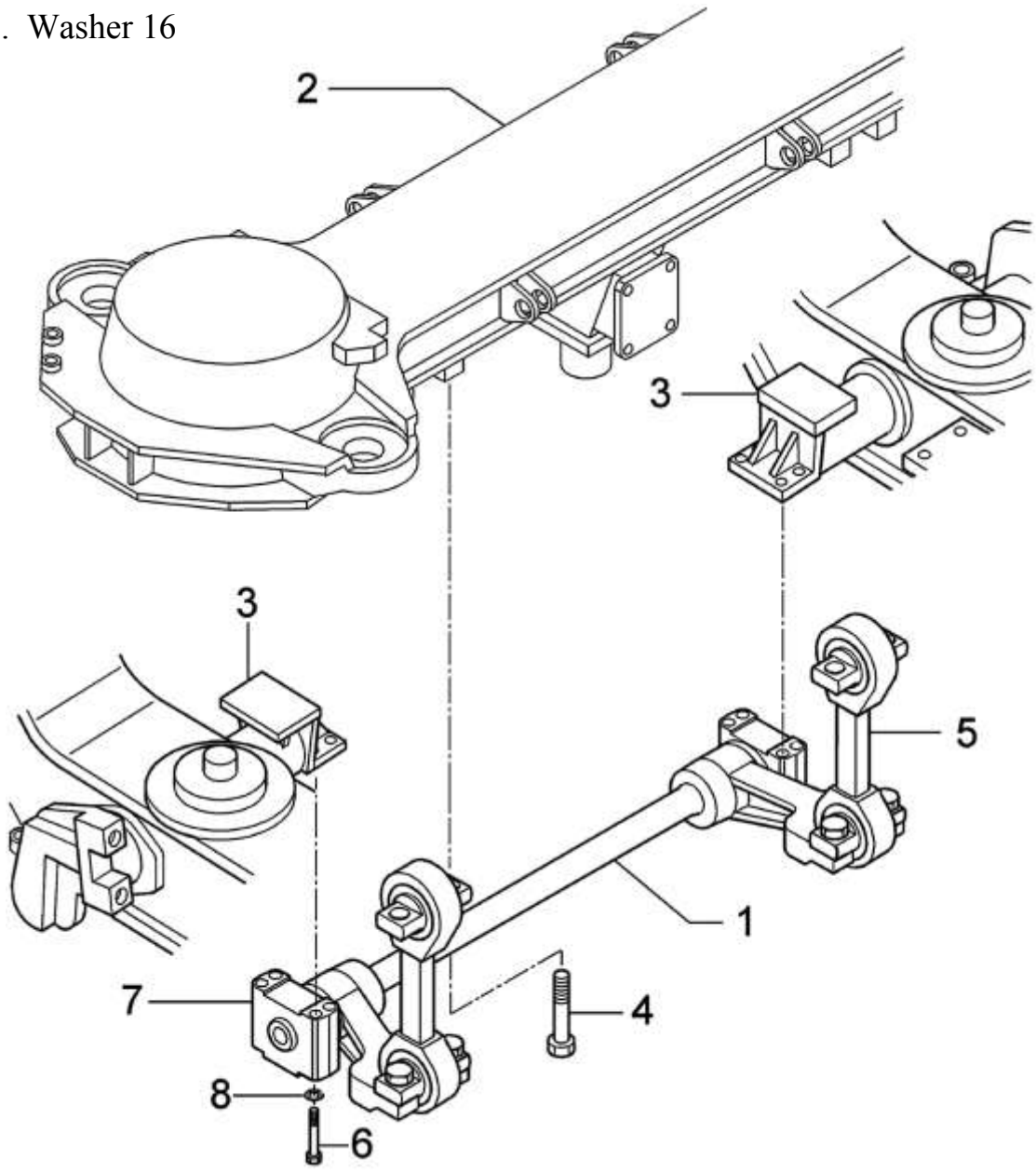
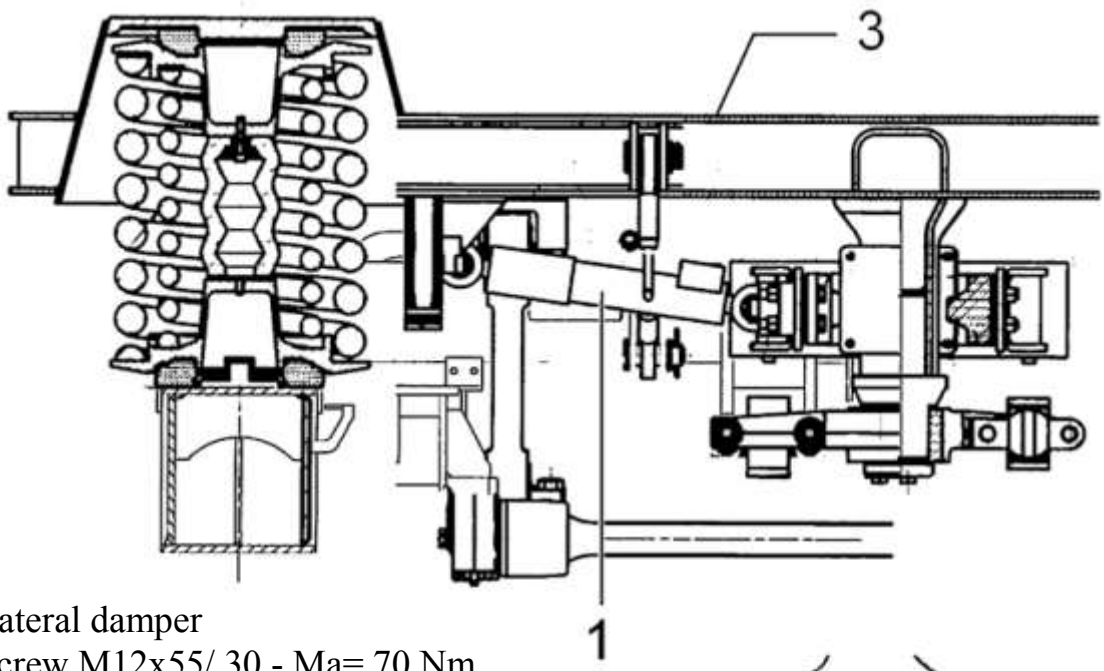


FIG. 3-95 Mounting the Anti – Roll Bar

4.6.15 Mounting Vertical and Lateral Dampers

Mount the lateral damper (1 - FIG. 4-96) screwing its ends to the bolster beam (3) and to the supports (6) on the central frame.



1. Lateral damper
2. Screw M12x55/ 30 - Ma= 70 Nm
3. Bolster beam
4. Washer 12
5. Nut M12
6. Frame supports

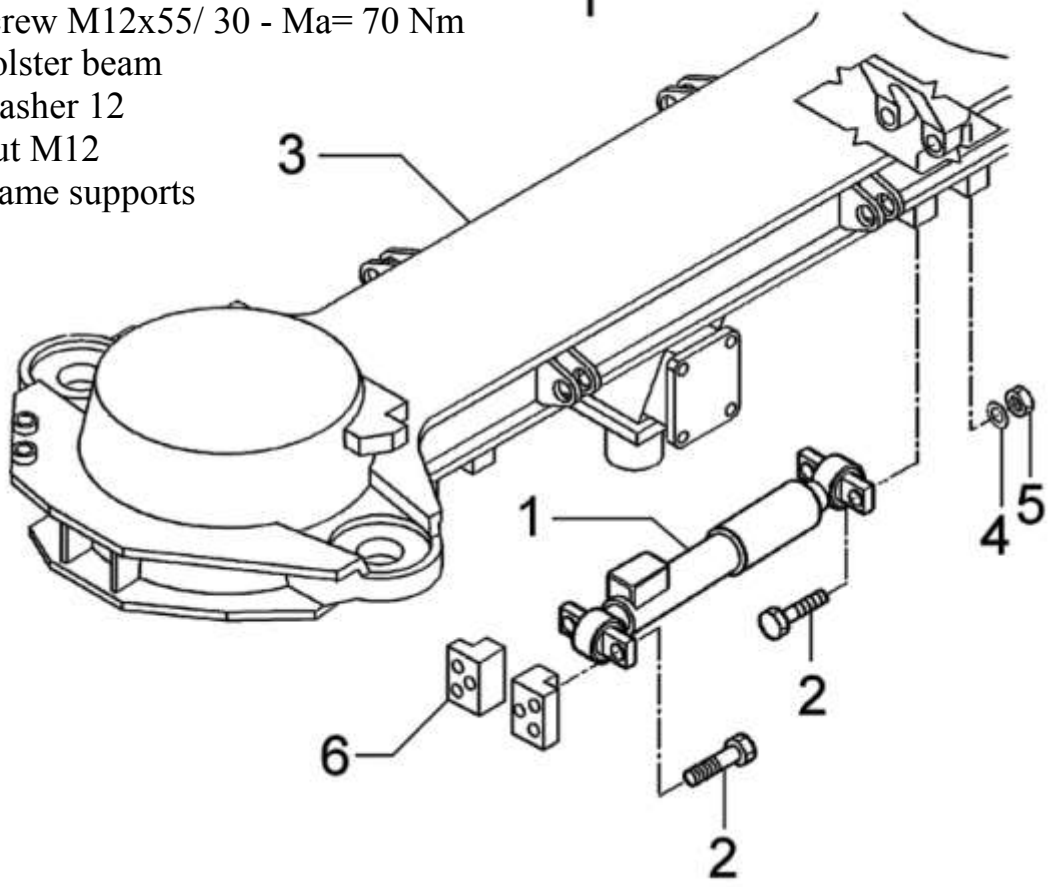


FIG. 3-96 Mounting Lateral Damper

Mount the vertical dampers (1 - FIG. 4-97), one on each side of the bogie: screw the upper end to the bolster beam (3) and the lower one to the bogie frame (5).

1. Vertical damper
2. Screw M12x100/ 30 - Ma= 70 Nm
3. Bolster beam
4. Screw M12x70/ 30 - Ma= 70 Nm
5. Bogie frame
6. Washer 12
7. Nut M12

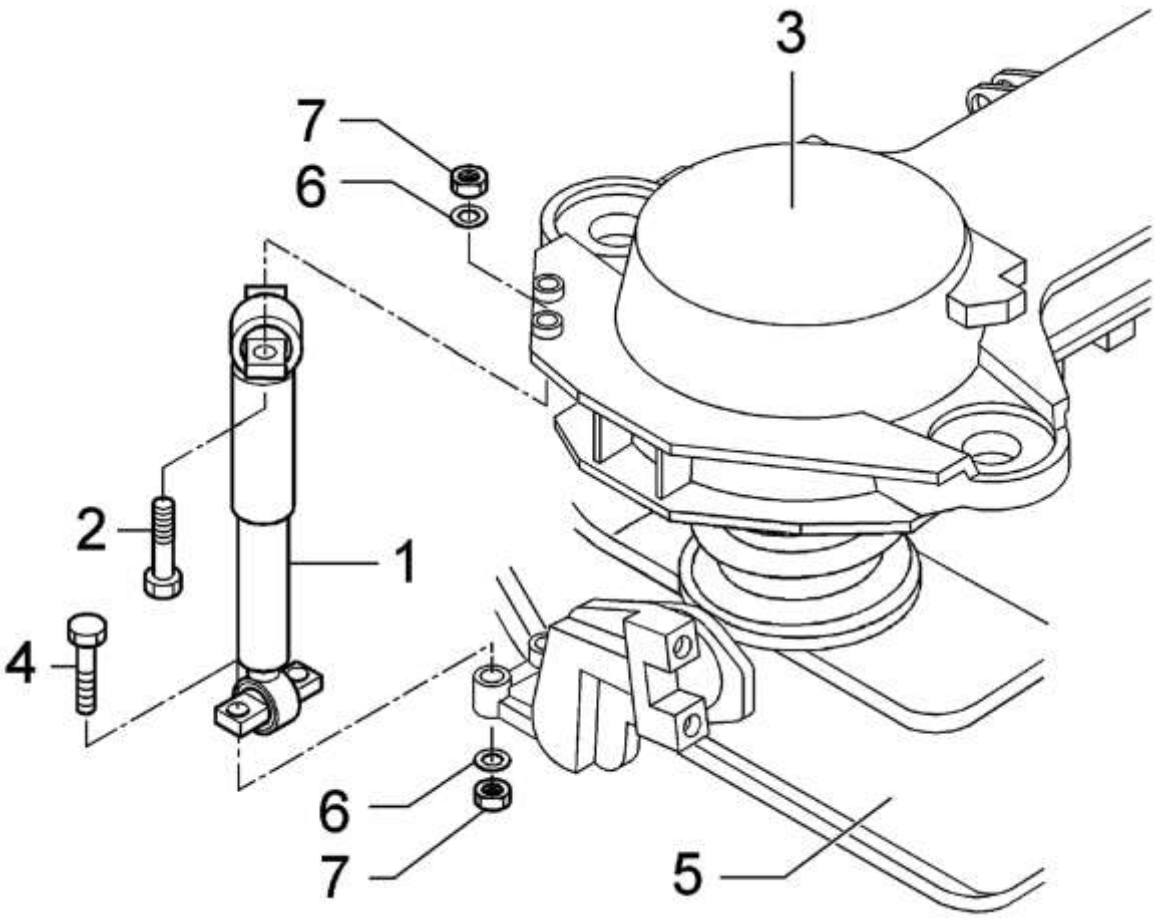


FIG. 3-97 Mounting Vertical Dampers

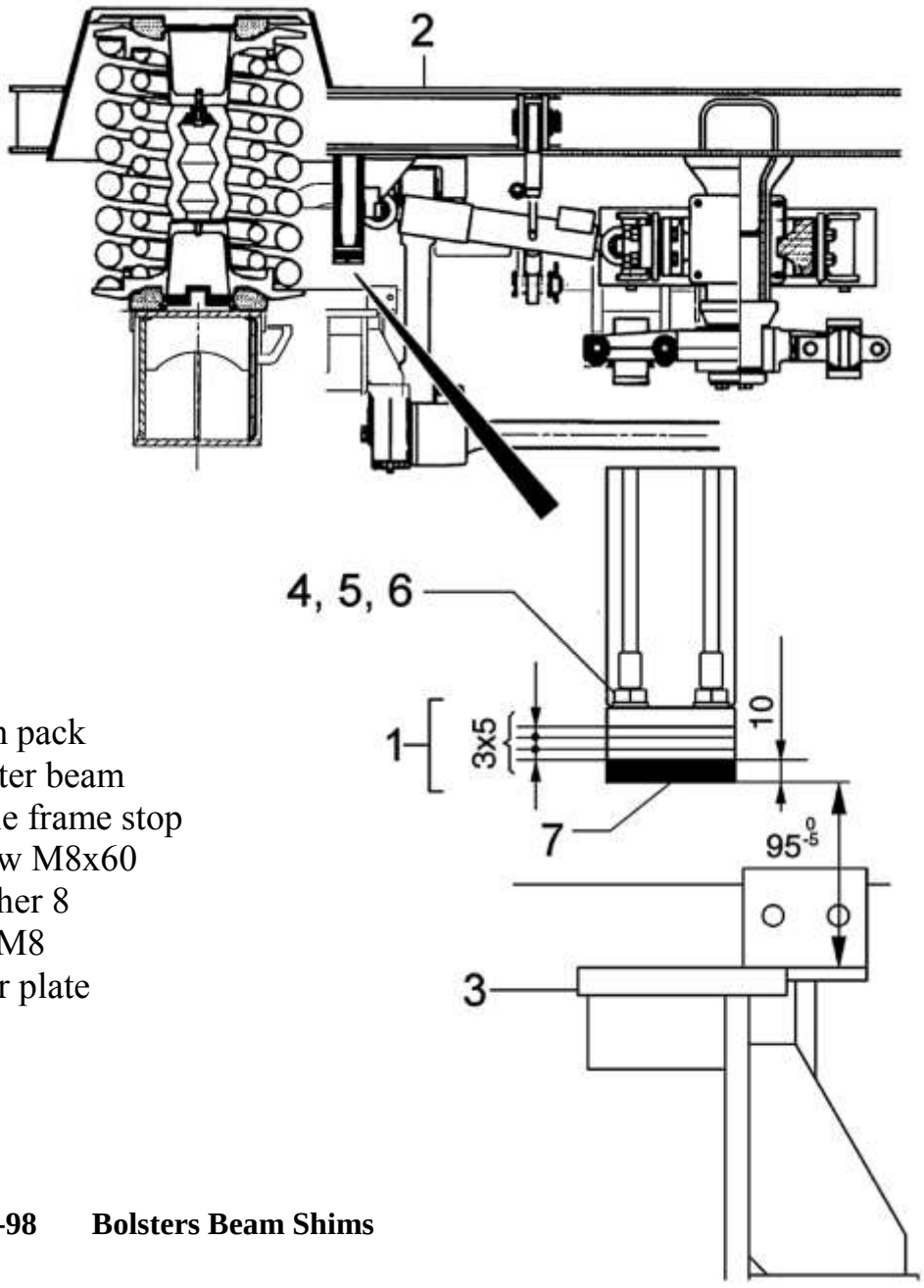
4.6.16 Brakes Pneumatic System Check

After mounting the bogie, perform a functional test on the braking equipment, using a manometer in order to check the working pressure: connect air supply to the system and check the following:

1. Test movement of brake levers under a pressure of 4 bars
2. Test sealing of the pneumatic system: supply air to the brake units of one axle, seal the plug and check that after 10 minutes pressure drop is not higher than 0,2 bars.

4.6.17 Check Shimming Under the Bolster Beam

Under tare load conditions, check that distance between the shims (1 - FIG.4-98) under the bolster beam (2) and the bogie frame stops (3) lies within the shown values (95 +0 -5 mm). The shim pack (1) is made by three 5 mm and one 10 mm wear plate (7). The same check must be performed after mounting the bogie under the car body.



1. Shim pack
2. Bolster beam
3. Bogie frame stop
4. Screw M8x60
5. Washer 8
6. Nut M8
7. Wear plate

FIG. 3-98 Bolsters Beam Shims

4.6.18 Bogie Pressing and Testing

In this clause the reference drawings and tables needed for the bogie pressing are found. Please refer to Alstom documentation for details.

4.6.19 Connecting the Bogies to the Car Body

Before operating the connection between the bogie and the car body, it is necessary to preassemble the items (3, 4, 8, FIG. 4-99) on the bogie, and items (1, 2, 7) on the car body.

CAUTION: STRICTLY RESPECT PRESCRIBED TIGHTENING TORQUE FOR NUT (6)

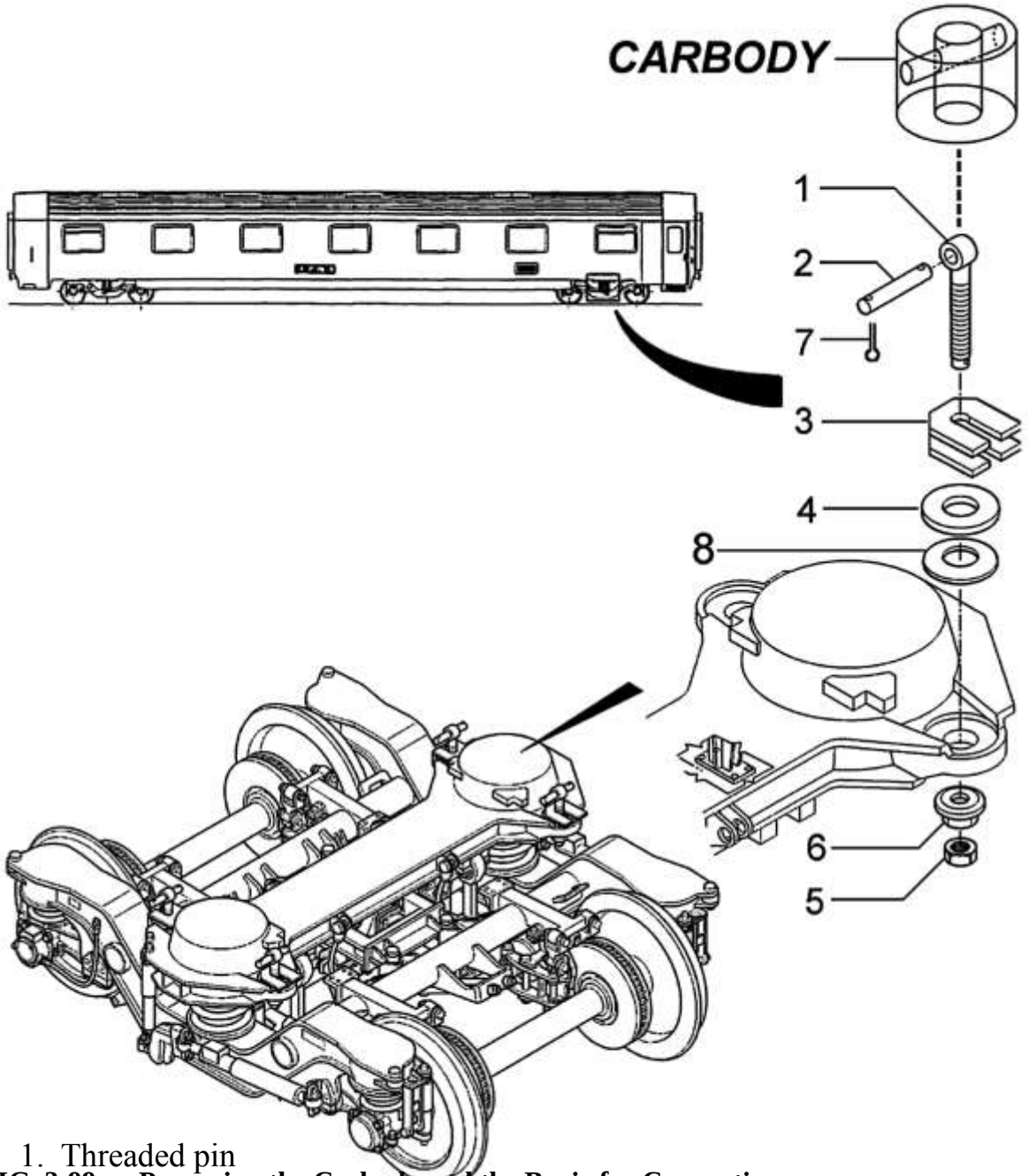


FIG. 3-99 Preparing the Carbody and the Bogie for Connection

1. Threaded pin
2. Pin
3. Shims
4. Washer
5. Locknut
6. Nut bogie- car body - Ma= 250 Nm
7. Split pin
8. Plate spring

A Lift the car body using four lifters under its sides and roll the bogies under the car body

B Lower the car body with care, in order to engage the bogies

C Check car-body height over the rail: if necessary, insert an equal number of shims on both sides of each bogie.

D When the height is correct, proceed to point E.

E Lock the four threaded pins (1) using the nuts (6) and the locknuts (5).

F When the bogies are engaged and fixed remove the lifters.

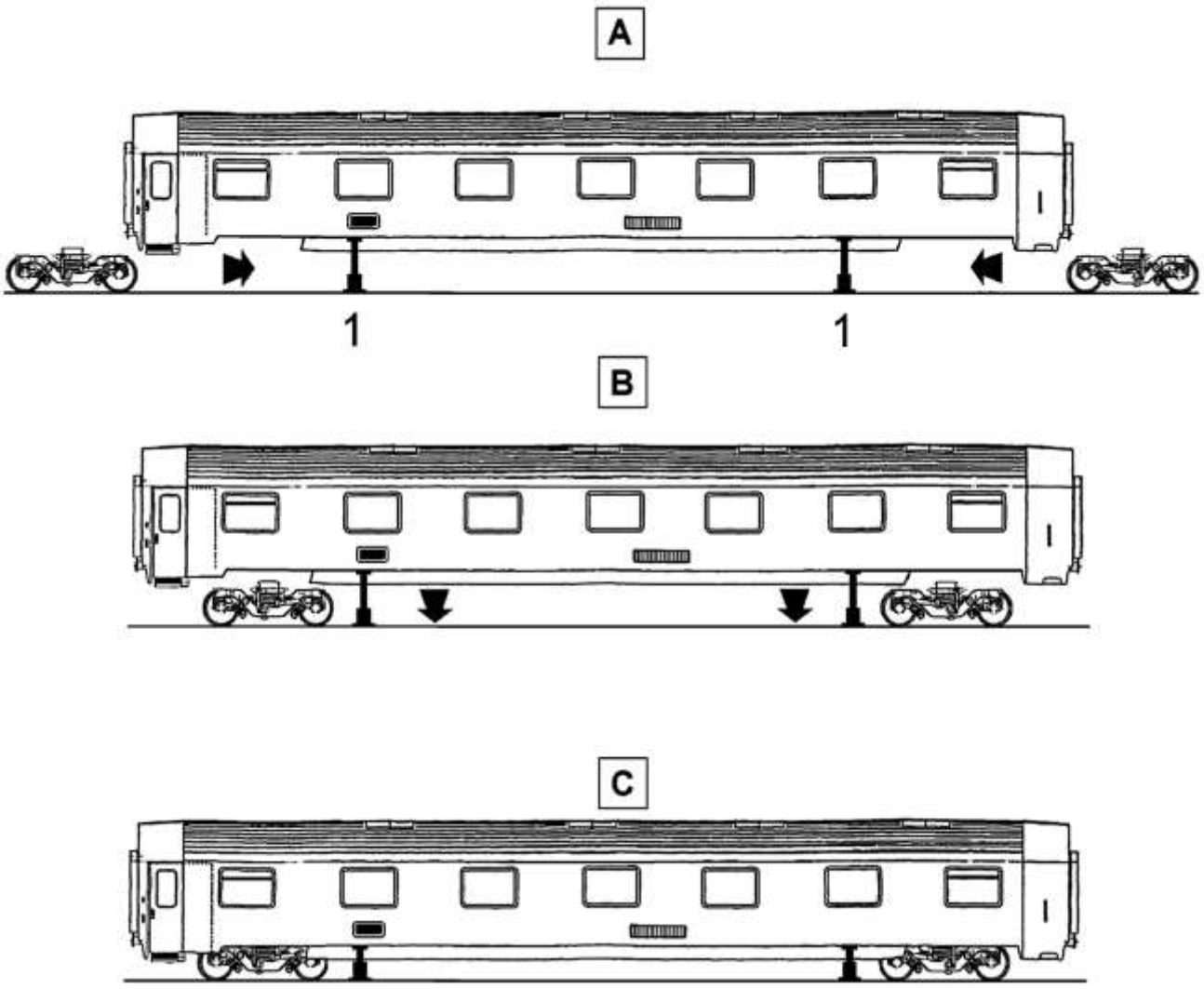


FIG. 3-100 Putting the Bogies under the Car Body

After lowering the car body, mount the yaw dampers (1 - FIG. 4-101) connecting them to the bogie frame (5) and to the car body supports (6).

1. Yaw damper
2. Screw M16x120 - Ma= 170 Nm
3. Washer 16
4. Nut M16
5. Bogie frame support
6. Car body support

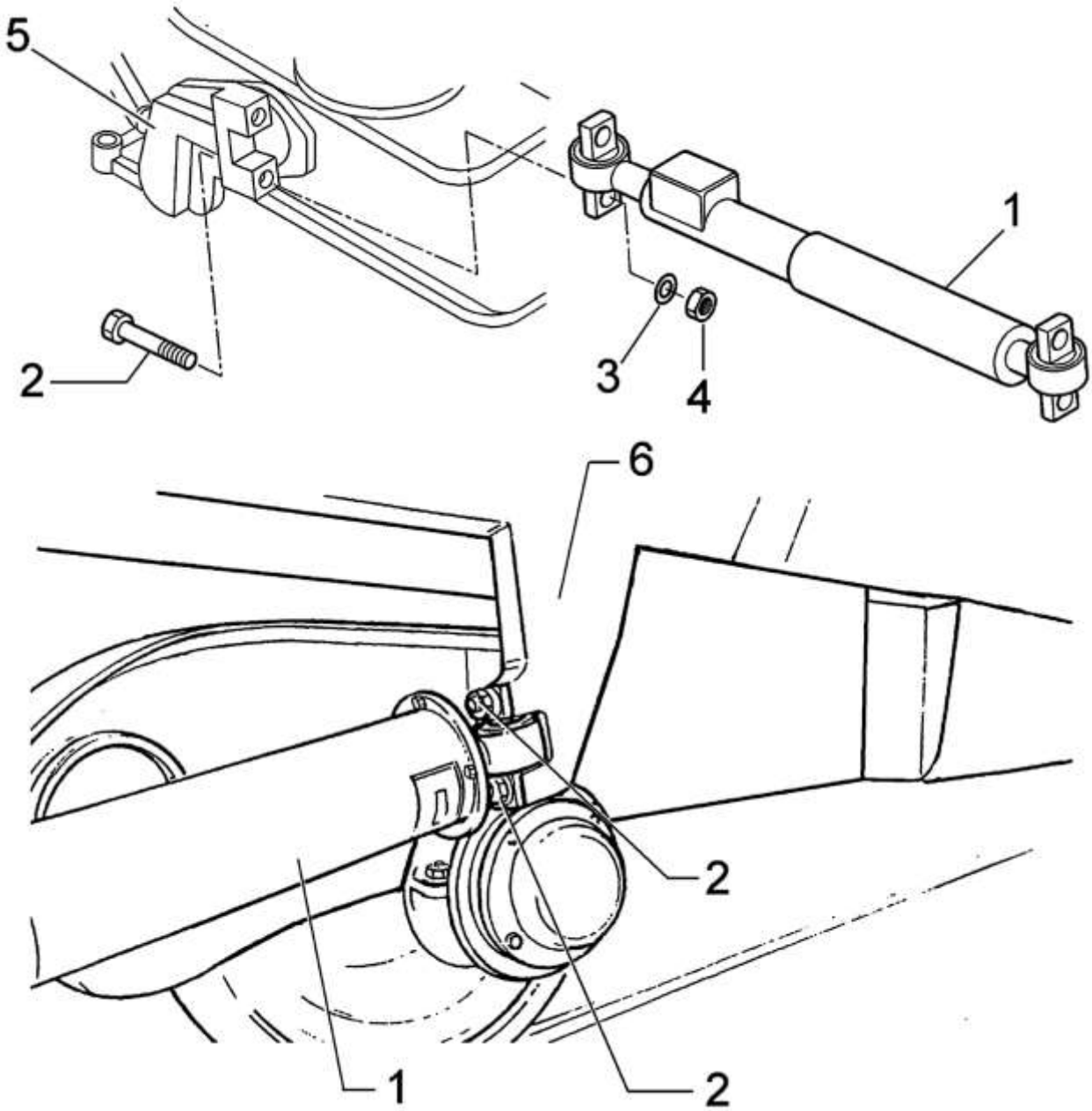
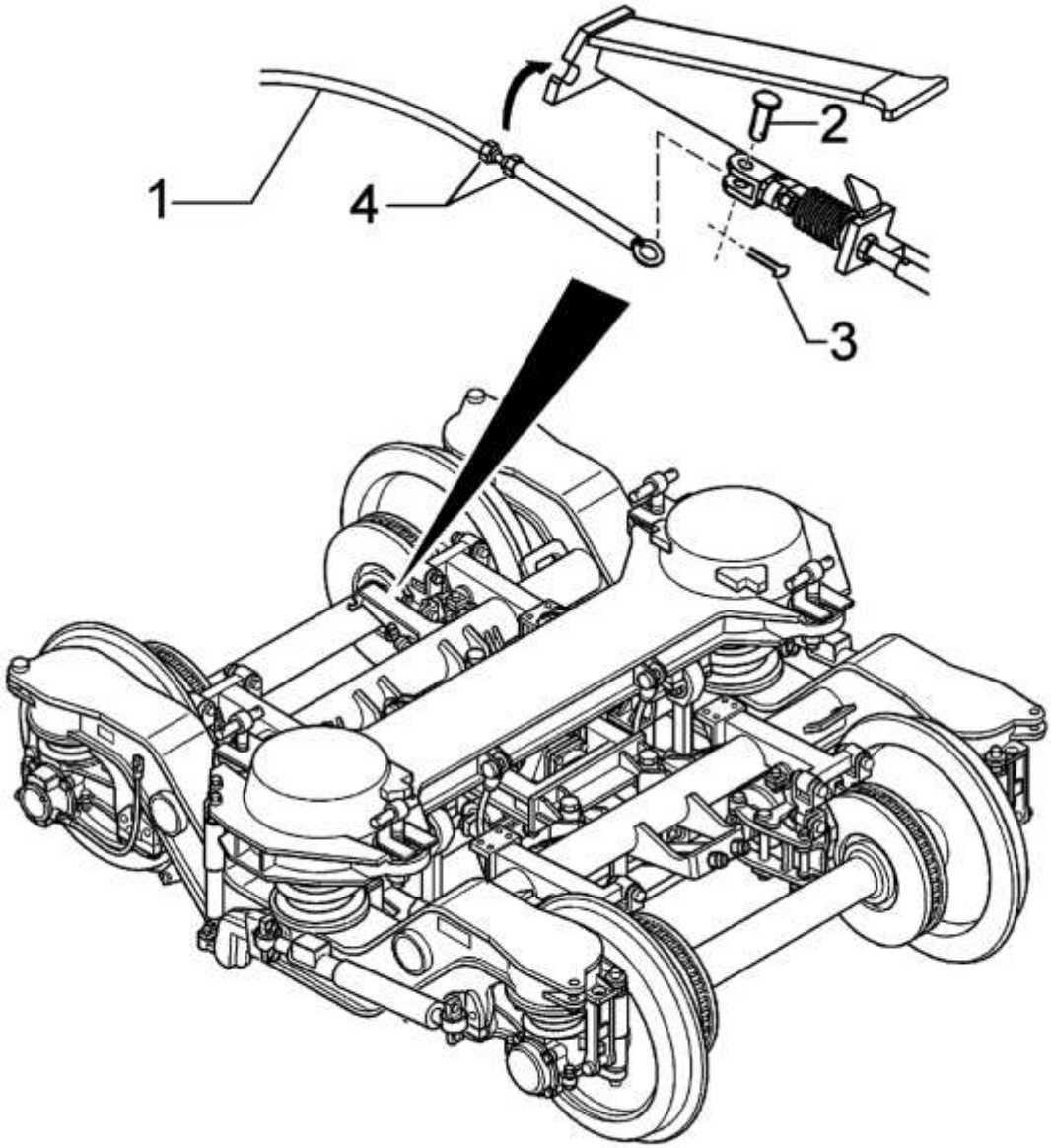


FIG. 3-101 Mounting Yaw Dampers

4.6.20 Final Connections

Perform the final connections of the bogie to the car body:

1. Electric cables for the sensors mounted on the axle bearings
2. Cables of the handbrake (bogie 1267334 only). Connect car body cable (1) to bogie one using pin (2). Secure pin (2) using split pin (3). Lock nuts (4) on bogie frame support.
3. Pneumatic connections
4. Earthing cables between the bogie and the car body



1. Handbrake cable – car body side
2. Pin
3. Split pin
4. Nut

FIG. 3-102 Connection of Handbrake Cables

4.6.21 Table of Lubricants

In the following table are shown some lubricants which are suitable for being used during the trailer bogie assembling and maintenance on the components listed below:

Group	Component	Lubricant
Wheel set	Axle Brake disc pressure mounting Brake disc mounting Whole and split Brake disc mounting Axle bearings	Molykote Paste G, Credimex AG 6060 Sarnen Leinol Rindertalg Molykote M55 Getriebekonzentrat M44 Glycerin Molykote 321 R ESSO Beacon 2
Primary suspension	Control arm support Bearing seat bearing Control arm	Blasol 135 or ESSO Beacon 2 CAREBOX 0018529 ISVA Orbassano (Italien) ESSO Beacon 3 Shell 4589-A Tectyl 506 Klüber Blasol 135 Blaser
Secondary suspension	MANNESMAN-SACHS-damper	Damper oil K10
Brakes	Brake joints Flexball	Staburags NBU30 PTM Klüber Blasol 135 Blaser

4.6.22 Screwed Connections

All the screwed connections used in the bogie design are mounted according to the principle of „tightening torque". Tightening torques are calculated according to a required pre-load and other functional parameters. The torque max dispersion lies within ± 10 %.

4.6.22.1 Torque Controlled Tightening

„Torque controlled tightening" means the use of dynamometric wrenches provided with an indicator and torque-controlled motors for the tightening. The tool requisites are defined according to DIN 25202 and include the tightening coefficient α A (preload and applied torque dispersion) and must comply to B Class screwed connections according to DIN 25202.

4.6.22.2 Contact Surfaces

In screwed connections subjected to heavy working loads (those having a specified tightening torque) the contact surfaces A, B, C and D (FIG. 4-103) must be worked out without varnishing and base coating. Contact areas must be machined in order to be plain and parallel.

E and F surfaces must comply to ISO 898 rules.

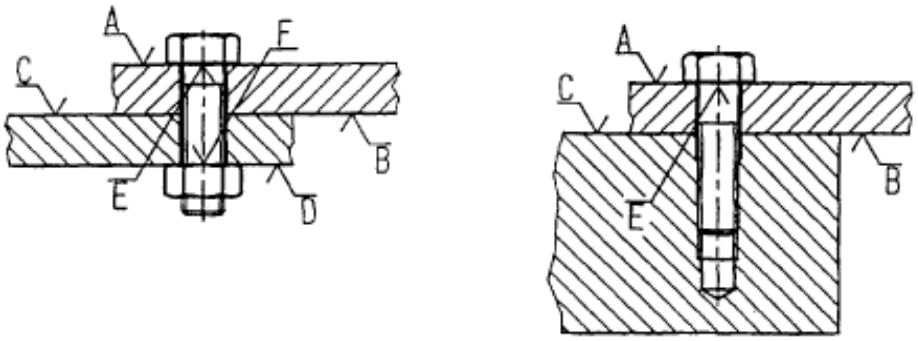


FIG. 4-103 Contact Surfaces In Screwed Connections

4.6.22.3 Securing a Connection with Liquid Glue

In order to secure a screwed connection it is possible to use special glues which generate a rigid junction (with dismounting possibilities) between the internal and external threads of a screwed connection.

Before using such glues, it is necessary that both threads of a connection are clean and un greased.

4.6.22.4 Tightening Torques

In the tables below are listed the tightening torques to be used when mounting screwed assemblies. Listed torques are the result of a calculation involving the screw preload Fm, the torque exerted by the threads and the friction coefficients of the threads and of the screw head.

The resulting stress is equal to 90 % of the limit load yield of the screw.

Torques for Class B screwed assemblies according to DIN 25202.

Screw type	Tightening torque Ma	Preload at mounting Fm
M 8	2.14 Kg-M	17 900 N
M 10	4.07 Kg-M	28 500 N
M 12	7.13 Kg-M	41 500 N
M 16	17.33 Kg-M	78 000 N
M 20	34.67 Kg-M	126 000 N
M 24	60.163 Kg-M	182 000 N
M 30	119.30 Kg-M	290 000 N

Reduced torques for Class C and D screwed assemblies according to DIN 25202

Screw type	Tightening torque Ma	Preload at mounting Fm
M 8	1.22 Kg-M	10 600 N
M 10	2.44 Kg-M	17 100 N
M 12	4.28 Kg-M	25 100 N
M 16	10.19 Kg-M	46 000 N
M 20	21.41 Kg-M	77 000 N
M 24	36.19Kg-M	109 000 N
M 30	71.38 Kg-M	172 000 N

NOTE: These torques are to be used when no other special torque is stated.

4.6.22.5 Procedure of maintenance of Corrosion of LHB FIAT Bogie Frame:

Procedure for maintenance & prevention from corrosion of LHB design FIAT Bogie frame is strictly advised to be adopted during Shop Schedule to minimize corrosion.

Reason: RCF has mentioned that, FIAT bogie frames are more susceptible to stone hitting as it is at a much lower height because of „Y" shape as compared to ICF bogie frame.

Action: FIAT bogie frame should undergo stringent maintenance procedure during Shop Schedule (IOH/POH) to prevent it from the corrosion.

Procedure to be adopted for FIAT Bogie frame maintenance by workshop is as under:

1. Cleaning of bogie frame.
2. Washing with suitable detergent as per RCF T S No. 17.617 100 Ver. 02
3. After cleaning and scrapping, check the depth of dent marks. Small pitting holes up to a maximum depth of 3 mm may be permitted provided these are
   a. Staggered and non-continues
   b. are not concentrated on the bottom bend portion of the side frame
4. It is recommenced to remove rust by de-scaling by adopting suitable method of grit/shot blasting or by using rust converter to IS:13515-92 (STD ISI marked product) for removal of corrosion.
5. It is recommended to use rust remover during maintenance only where grit/shot blasting is not possible, as Rust remover is not a substitute for grit/shot blasting.
6. Apply high build epoxy primer (RCF PL No. 34550028 – High performance anti corrosion epoxy coating (two packs) to the RDSO Specification No. M&C/PCM/123/2006) as per RCF"s Spec. No. MDTS 166.
7. Apply High build epoxy paint (RCF PL No. 33597133 – Epoxy based elastified top coat (two components) shade RAL 7012) as per RCF"s Spec. No MDTS 166.

4.6.22.6 Maintenance of springs of FIAT bogie of LHB Coaches:

Following instructions should be followed while maintaining springs of FIAT Bogie of LHB coaches:-

1. **Paint removing: -** Existing paint should be removed by using sand blasting technique. Scrap spring by wire brush till facility of sand blasting is not available.
2. **Magna flux test:-** Magna flux test is essential for the detection of surface cracks of springs as per the clause 5.3 of FIAT spec. No. 17.248 100 Ver. 05. Till the testing facility is made available, visual inspection with magnifying glass shell be done.

3. **Surface Protection:-** For surface protection alkyd based painting is to be done. The normal method of alkyd painting should be followed as explained in Para 8 of spec No. 17.248 100 Ver 05. It is given below:-

A). **Phosphatizing:-** It is to be carried out by using zinc phosphate. Fine crystalline Coat of 5 to 10 µm should be formed on the surface.

B). **Priming:-** It is to be carried out by using Synthetic resin metal primer of following contents:

a. Basis	: Alkyd resin, air and oven dried
b. Pigmentation	: Zinc phosphate, heavy chips, talcum, tinting pigments
c. Solvent	: Aromatic substances
d. Dry layer thickness	: Approximate 80 µm

C). **Coating Lacquering:-** It should be carried out by using Synthetic resin dipping enamel with following contents:

a. Basis	: Alkyd resin, air and oven dried
b. Pigmentation	: Lampblack tinting pigments, extender
c. Solvent	: Aromatic substances - aliphates
d. Dry layer thickness	: Approximate 40 µm
e. Colour	: Colour of the coating lacquer is to be stated in the text of order.

4. **Coupling and installation:-** Coupling and installation of the springs should be followed as per the clause no. 3 & 5 of TS Nr. 17.471 101 Ver 01 as explained below:-

Alignment deviation:

Each spring is provided with following data:

a. Aluminum plastic adhesive band – The positive direction of the alignment deviation

b. Nonferrous metal band (copper tag) – The length of the spring under test load L_1 and the value of alignment deviation (in mm). It should always be at upper position.

Coupling Instruction for <u>New Springs</u> [Clause No. 3 of TS 17.471.101 ver. 01]:

Pairing of the spring:

a. The difference between the alignment deviations of the two outer springs should **<u>not exceed 4 mm.</u>**

b. The difference between the alignment deviations of the two inner springs **<u>should not exceed 8 mm</u>**.

c. The outer and inner springs with the greater alignment deviations must be situated in the same spring assembly i.e. the combination of inner and outer spring at any side should be of greater deviations.

d. The difference between lengths over test load (L_1) of outer springs should not be more than 2 mm.

e. The difference between lengths over test load (L_1) of inner springs should not be considered.

Coupling Instruction for <u>Serviceable Springs</u> [Clause No. 5 of TS 17.471.101 ver. 01]:

Pairing of the spring:

a. The difference between the alignment deviations of the two outer springs should **<u>not exceed 8 mm.</u>**

b. The difference between the alignment deviations of the two inner springs must **<u>not be taken into consideration</u>**.

c. The outer and inner springs with the greater alignment deviations must be situated in the same spring assembly i.e. the combination of inner and outer spring at any side should be of greater deviations.

d. The difference between the lengths over test load (L_1) of outer springs should not be more than 2 mm.

e. The difference between lengths over test load (L_1) of inner springs should not be considered.

5. **Installation of springs:**

The Aluminum band of the outer spring should be at outer side and that of the inner spring should be at inner side.

6. **Colour coding of springs:**

For identification of springs, paint the middle coil of spring as per the colour coding chart explained by RCF vide letter No. MD23151 dt 23.11.02

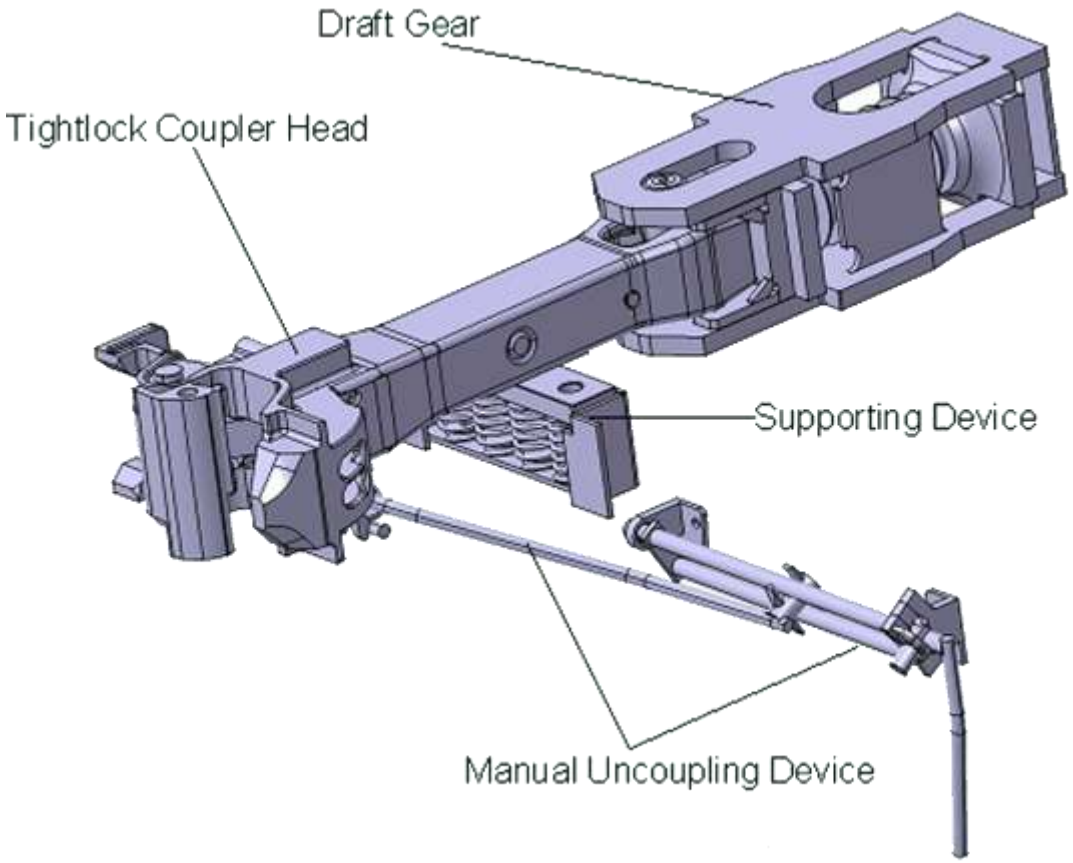
4.6.22.6.1 LOAD TEST CHART FOR SPRINGS OF FIAT BOGIE OF LHB COACH

PL No. (Drg No)	Nomenclature	No. of Coils	Free Height	Wire Dia	Outer Dia	Inner Dia	Height under Load KGF	mm	Colour Code
PRIMARY OUTER SPRING									
33503035 (1267411)	AC Two Tier	5.5	324.5	38	257	181+3/-0	2948	264+0/-4	Green
	AC Three Tier								
	Pantry Car								
	AC Ist Class								
	AC Chair Car(Ist)								
	AC Chair Car								
33500368 (1277142)	Power Car	5.75	337	40	259	179+3/-0	4825	252+0/-4	Yellow
PRIMARY INNER SPRING									
33503047 (1267412)	AC Two Tier	7.5	324.5	26	164	112+3/-0	1736	264+0/-4	Green
	AC Ist Class								
	Pantry Car								
	AC Chair Car(Ist)								
	AC Chair Car								
33500356 (1277143)	AC Three Tier	7.8	337	27	165	111+3/-0	2690	252+0/-4	Yellow
	Power Car								
SECNDARY OUTER SPRING									
33503060 (1269514)	AC Two Tier	6.6	707	50	418	318+3/-0	4796	512+0/-5	Green
	AC Ist Class								
	Pantry Car								
	AC Chair Car(Ist)								
	AC Chair Car								
33500400 (1268836)	AC Three Tier	7	702	55	427	317+3/-0	6041	515+0/-5	Yellow
	Power Car Side-II								
33500381 (1277146)	Power Car Side-I	7	708	56	429	315+3/-0	7291	512+0/-5	Blue

PL No. (Drg No)	Nomenclature	No. of Coils	Free Height	Wire Dia	Outer Dia	Inner Dia	Height under Load KGF	mm	Colour Code
SECNDARY INNER SPRING									
33503059 (1269513)	AC Two Tier	8.3	663	34	280+ 0/-2	212	2575	468+0/-5	Green
	AC Ist Class								
	AC Three Tier								
	Pantry Car								
	AC Chair Car(Ist)								
	AC Chair Car								
33500393 (1268837)	Power Car Side-II	8.5	658	37	280+ 0/-2	206	3488	471+0/-5	Yellow
33500370 (1277145)	Power Car Side-I	8.7	664	38	281+ 0/-2	205	3947	468+0/-5	Blue

NOTE

CHAPTER 5



COUPLER & BUFFING GEAR

CONTENTS

CHAPTER 5

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CHAPTER 5

COUPLER & BUFFING GEARS

5.0 INTRODUCTION

The connection between two adjacent vehicles within a train set is done by a "Coupler System" consisting of the coupler itself and a draw and buffing gear.
The center buffer couplers used on LHB coaches are tight lock center buffer couplers of AAR type H. They can be coupled with AAR type "E" center buffer couplers fitted on locomotives.

The centre buffer coupler combines the draw and buffing gear in one. It is able to transmit both the tensile and the compressive forces. Further the tight lock coupler by its special design, hinders the climbing of the vehicles in case of an accident.

The AAR type H coupler is a CBC, enabling automatic coupling in straight lines, in curves, and also (with some limitations) in the transition between straight lines and a curve.

The "Coupler System" allows a vertical angle of deflection of ± 7 deg. and horizontal angle of deflection of ± 17 deg.

During coupling, the "opened" knuckle will be turned in the coupled position by the shape of the adjacent coupler. In this position a lock moves down in a position, so that the knuckle is fixed in the coupled position. During uncoupling, the lock moves to the top by a turning movement of a lever on the coupler head and the knuckle becomes free. The uncoupling is done by using the uncoupling facility consisting mainly of a rod system. Referring to a single vehicle, uncoupling is only possible from one side of the coach (only from the right side when looking on the end wall of coach).

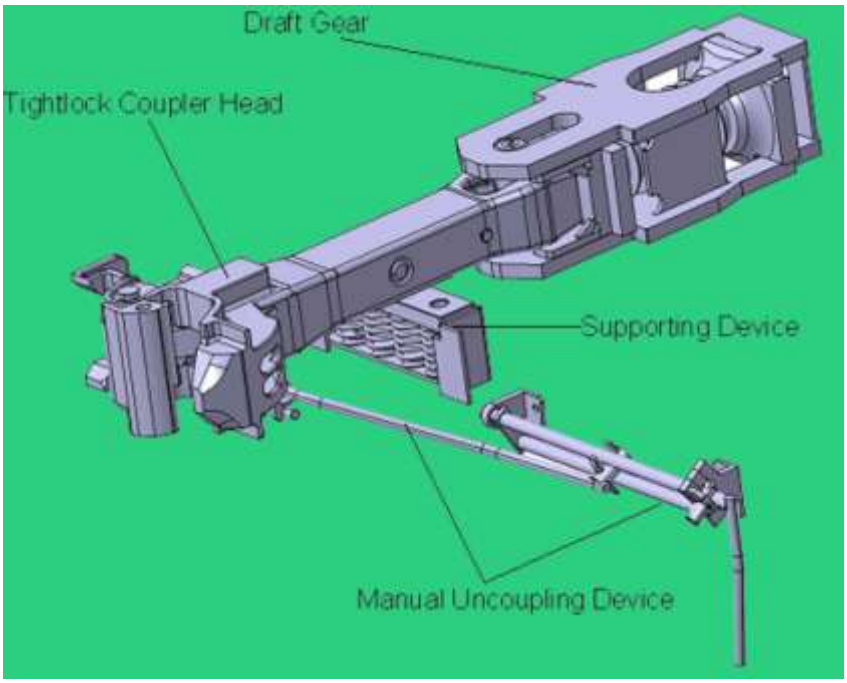


Figure:5.1 Coupler Assembly

5.1 DESCRIPTION OF THE COMPONENTS

Main components of the coupler system are:

- Tight lock coupler head (AAR type H) with drawbar.
- Drawbar guide (Support)
- Draft Gear
- Manual uncoupling device.

5.1.1 Tight Lock Coupler Head Type "H":

Coupler head is a standard AAR „H" type tight lock coupler head with an uncoupling device that can be operated from outside the track. The coupler head has a Shank/Draw bar cast together with the head. Parts like knuckle, lock etc, are assembled in the coupler head to enable coupling and uncoupling. Tail end of the draw bar is provided with UIC stabilizing link and connects to the draft gear through the central pin.

A backlash compensation device is assembled in the shank at tail end of coupler head. This device is held in position by two side bolts that are to be removed only after installation on the coach.

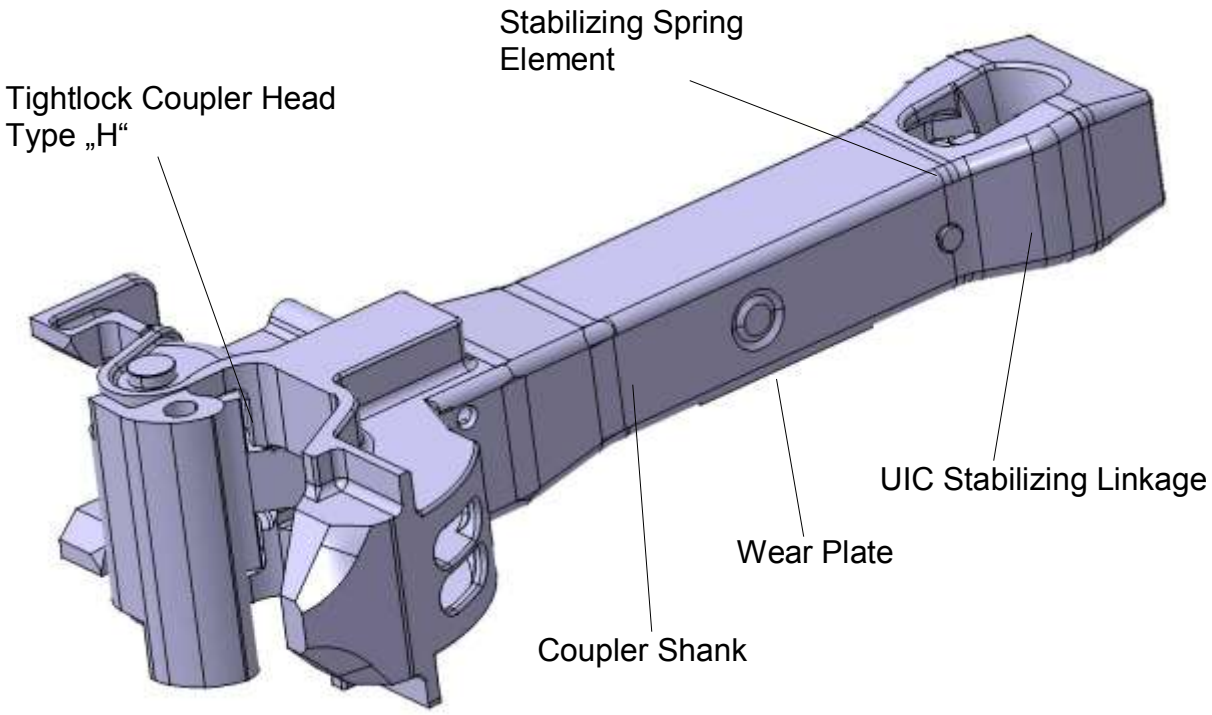


Figure: 5.2 Tight lock Coupler Head

5.1.2 Supporting Device

The Supporting device comprises of four preloaded compression springs. The device is placed on a platform and bolted to the car structure. The coupler head rests on the top wear plate of the Supporting device and this device supports the coupler weight.

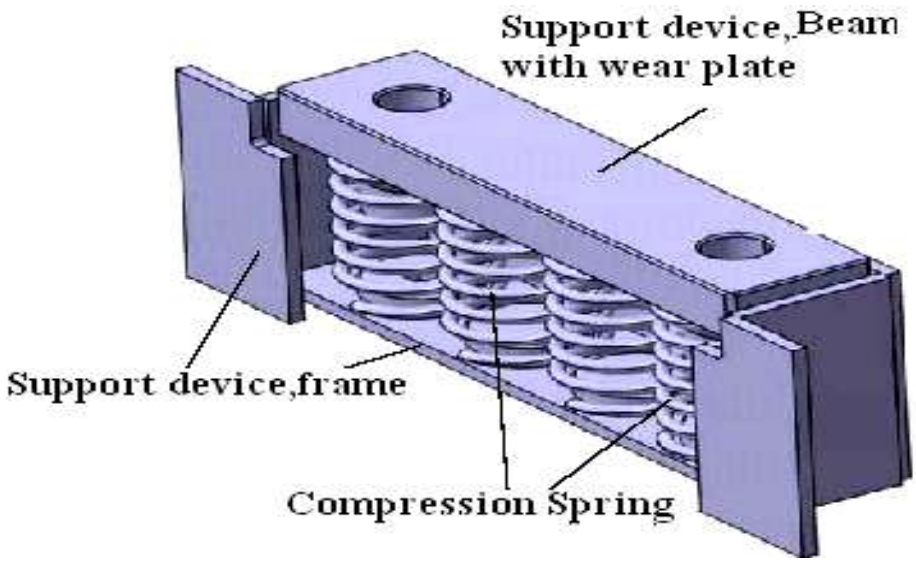


Figure: 5.3 Supporting Device

5.1.3 Draw Gear

The draft gear is a double acting device for energy absorption. The device is designed to fit into the draft gear pocket of the coach and absorbs the dynamic energy in both draw and buff modes. The max tensile stroke and buff stroke is 58 mm and 90 mm (max).
Note: Front stoppers and Rear stoppers are welded in the draft gear pocket of coach.

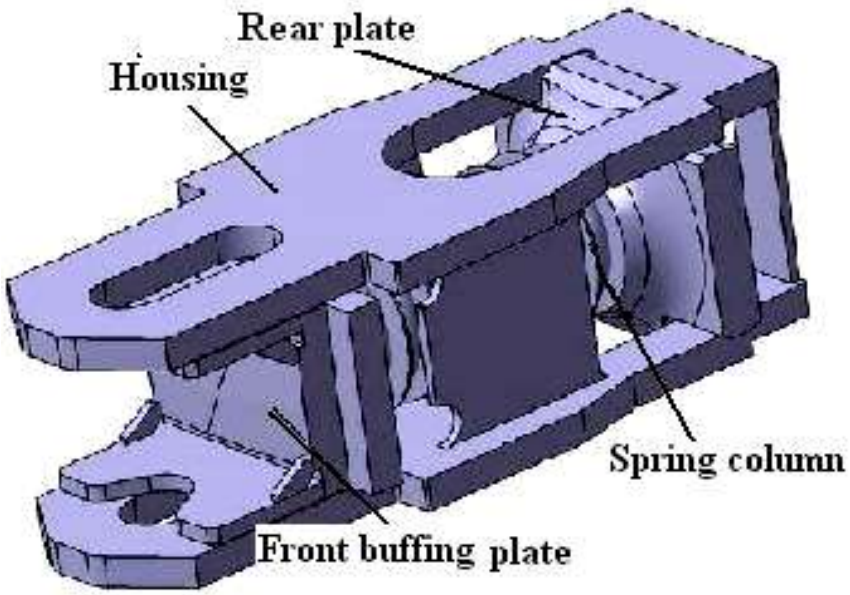


Figure:5.4 Draft Gear

5.1.4 Manual Uncoupling Device

The manual uncoupling device is a combination of levers and rod.

The manual uncoupling device is mounted on one side, near end-wall of coach, connecting the uncoupling mechanism on coupler head through the sliding rod. Handle of the device is unlocked, lifted and then rotated in the clockwise direction for uncoupling. After coupling, locking of the handle has to be ensured to prevent un-authorised uncoupling.

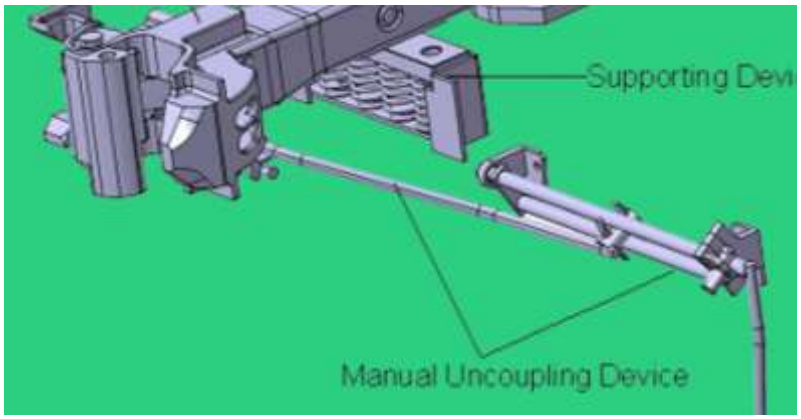


Figure: 5.5 Manual uncoupling device

5.1.5 Mounting Plates

Base plate and support plate are fastened to the under frame after mounting draft gear in the UIC pocket of coach. Base plate has a hole for inserting the central pin. A locking plate is fitted by sliding in between the central pin and base plate to prevent central pin from falling off. This arrangement facilitates fitment and removal of coupler head without removing the base plate. It is very important to use only high tensile bolts (Grade 10.9) for fastening the mounting plates.

5.2 TECHNICAL DATA

Coupler:

Material	High tensile Steel Grade "E" as per AAR Spec. M – 201 Q & T (As per Maint. Manual of ASF-Keystone)
Pattern	20140
Operation	Double rotary
Compressive strength (yield strength)	2000 kN
Tensile strength (yield strength)	1000 kN
Coupler length (from face to pivot)	1030 ± 5 mm
Weight of Coupler (approx.)	231.4 Kg
Maximum horizontal swing of Coupler	± 17.85°
Maximum vertical swing of Coupler	± 7°

5.3 COUPLING AND UNCOUPLING PROCEDURE

To facilitate the safe operation of building up trains and coupling of coaches by the tight lock couplers, it is absolutely necessary to follow the instructions given below.

"H"-Type coupler for the IR - Coaches has the following gathering range:

Horizontal: ± 110 mm
Vertical: ± 90 mm

It is to be understood, that these values of the coupler centre offsets are strictly valid when the coupler axes are parallel. (The values are as specified in technical specification C-K009 Rec.2 and RDSO/2011/CG-03 issued by RDSO).

5.3.1 Coupling Procedure

The coupling procedure is described as follows:

- Bring the vehicles near to each other at a slow speed (approx. 2 - 3 km/h) and stop the vehicles at approximately 1-meter distance of each other.
- Check alignment and position of coupler centers. Couplers must stand within the gathering range as given above.
- If required, pull the couplers manually towards each other and make sure that they are in the gathering range of the coupler geometry.
- Now push the vehicles together slowly (approx. 3 km/h) for coupling the two coaches.
- Check position of tell tale device for proper coupling (location of the tell tale is shown in figure below)
- Make sure, that the handle of manual uncoupling device is locked after coupling.

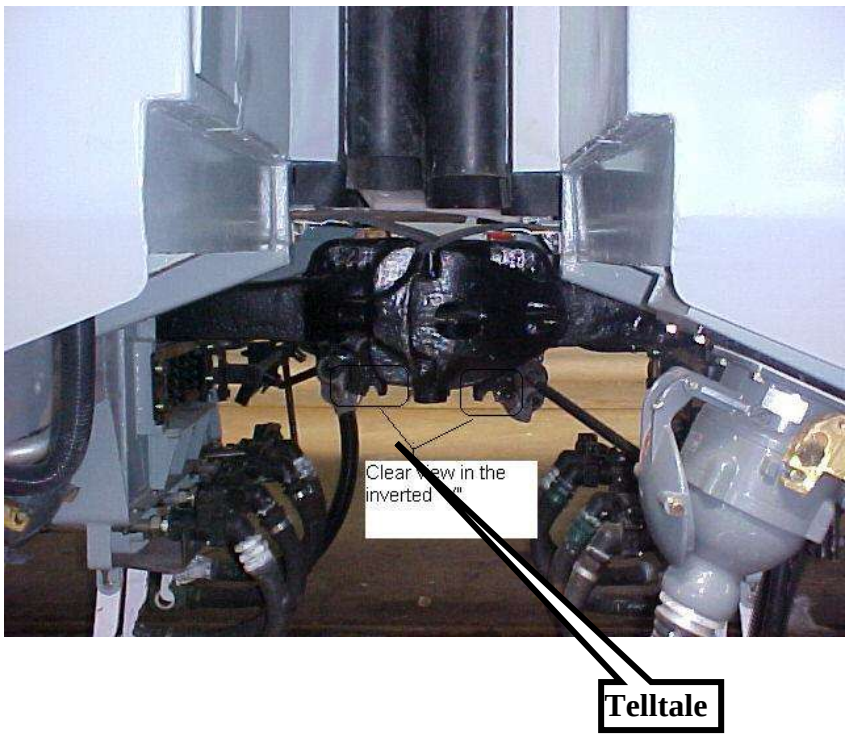


Fig: 5.6 Telltale position

5.3.2 Uncoupling Procedure

Unlock the handle by rotating locking screw with the special key. Lift and turn the handle in clockwise direction to a horizontal position (minimum 90°) and pull the coaches apart. Before uncoupling make sure that the couplers are not subjected to any tensile load and the uncoupling lever is fairly free to turn. A common practice for this uncoupling operation is also to push the vehicles together (with one vehicle applied with parking brake) to avoid excessive binding in the system.

5.4 PARTS LIST FOR THE TIGHT LOCK COUPLER HEAD

Item No.	Description	Qty
1	Coupler Head Body	1
2	Knuckle	1
3	Bush	4
4	Lock	1
5	Knuckle Thrower	1
6	Telltale	1
7	Bolt	1
8	Nut (3/8 UNC)	1
9	Split Pin (2 mm)	1
10	Lock Lift Lever	1
11	Rotor	1
12	Knuckle Pivot Pin	1
13	Grease Nipple	1
14	Knuckle Spring	1
15	Washer	1
16	Split Pin	1

5.5 COUPLER MOUNTING AND DISMOUNTING

5.5.1 Preparation of the Vehicle

The dimension of draft gear pocket on coach has to conform to that shown in the arrangement drawings.
Apply adequate grease on all bearing surfaces of draft gear and in the draft gear pocket before mounting the draft gear.
Mounting procedure/sequence to be followed for installation of coupler on the vehicle is described below.

5.5.2 Mounting of the Draft Gear

The spring column of the draft gear is pre-compressed by means of the mounting aid to a dimension of approx. 505 mm between the front buffing plate and the rear plate. This is important, to bring the draft gear within the dimension 510 mm of the pocket (between front and back stoppers).

The draft gear is lifted from the underneath into the draft pocket by means of a standard hydraulic lifting table. The draft gear is then secured in position by means of two mounting

plates on the bearing strips, on which adequate grease is applied – and 16 bolts of the specified size. Ensure that the Bolts are of Grade 10.9 and are tightened to the recommended (295±10 Nm) torque value.

5.5.3 Mounting of the Coupler Head

The coupler head is to be on a placed on a hydraulic lifting table or on the forklift and inserted into the draft gear from front end of coach, to connect the coupler head linkage to the draft gear by means of the central pin. The central pin has to be inserted through the hole in base plate from the bottom side of under frame of the coach. The position of central pin has to be secured by sliding the locking plate in between the base of central pin and base plate. Locking plate is secured by two M16 bolts/nuts. The bolts are to be tightened to the 200 Nm torque and locked with spring dowel/split pin.

5.5.4 Mounting of the Supporting Device

Holding the coupler head in lifted position (above horizontal), the supporting device is positioned on the vehicle platform below shank of coupler head before letting the coupler head to rest on the supporting device. The supporting device is then fastened using four bolts M20x 50 mm. The bolts are to be tightened to the 510 Nm torque value. Use of thread locking agent is recommended. Apply grease on the wear plate of supporting device.

5.5.5 Mounting of the Manual Uncoupling Device

To complete the coupler mounting, manual uncoupling device is to be fitted. Mounting brackets (2 types) are mounted on the vehicle structure and the manual uncoupling device is fastened to these mounting brackets. Uncoupling lever has to be connected to the coupler head before fastening the device to mounting brackets.

5.5.6 Removing the Mounting Aids

Mounting aid on draft gear (item 10 and 11 in drawing of draft gear) has to be removed using a ¾" Ratchet and socket 30 mm (preferably deep socket). Removing the mounting aid will release draft gear spring column to the designed preload position and the draft gear will be firmly seated in between front and back stoppers. Mounting aid on coupler head (item 4 in drawing of coupler head) has to be removed using the side pin puller. Removing this mounting aid will activate the backlash compensation device. The two holes on the shank of coupler head are then to be filled with grease.

The removed mounting aids will be required whenever coupler has to be dismounted from vehicle. Therefore these (mounting aids) are to be retained with the workshop for use in future.

Note:
Adequate greasing of surfaces of draft gear and surface of front stoppers on coach having relative motion has to be ensured during mounting. No grease or oil is allowed in the coupler head and its parts like knuckle, lock etc., as it will facilitate uncoupling and hence is dangerous. However adequate grease has to be applied at tail end and shank of coupler head having relative movement with supporting device, central pin and draft gear.

5.5.7 Final check of coupler installation

After completion of coupler installation the following functional checks are to be executed:

- Proper fastening and securing of all bolt connections to recommended torque.
- Free movement of the coupler head in horizontal and vertical direction.
- Free movement of the lever system of the manual uncoupling device.
- Functional check of the uncoupling device on coupler head by operating manual uncoupling device.
- Coupling and uncoupling test.

5.5.8 Dismounting of Coupler Head

Remove sliding rod from the rotary uncoupling device of coupler head by removing manual uncoupling device from mounting brackets fitted on coach.

Coupler head is dismounted first by pulling out central pin with central pin puller. To access the central pin, remove the base plate or remove the supporting device and only the locking plate from base plate. Support coupler head on a hydraulic lifting table while removing the central pin.

After removing coupler head following operation has to be done to keep coupler head ready for fitment again on coach.

Assemble backlash compensation device (UIC linkage assembly) into shank of coupler head, as shown in the drawing of coupler head. Place tail end of coupler head on a hydraulic press (minimum 10 T capacity) and compress the spring inside using a taper punch. Insert side bolts in two holes on coupler shank. Apply adequate grease to side bolts/holes. Side bolts shall be inserted by hand without use of external force.

5.5.9 Dismounting Draft Gear

Place a hydraulic table below the draft gear and remove all fasteners on the base and support plates. Assemble mounting aid of draft gear. Using a ratchet and 30 mm socket tighten the bolt so as to compress the draft gear spring. With adequate tightening draft gear leaves the stoppers and becomes free in the pocket. Slowly lower the hydraulic table ensuring that the draft gear slides down the pocket.

Procedure for Replacement of Draft Gear Assembly

1. Place the new draft gear assembly on the lifting trolley & lift trolley such that the draft gear will be guided in the draft gear pocket.
2. Loosen & remove the draft gear fixture bolt & adjust the draft gear in the pocket.
3. Provide the draft gear support plate on the under frame and tighten with proper specified torque.
4. Take the removed CBC shank on the hydraulic press & refit the UIC linkage by pressing the taper pin fixture. Then provide the UIC linkage locking pin from both side of the CBC shank. Ensure whether UIC linkage is properly locked or not.
5. Fit the CBC shank on the draft gear assembly under the coach.
6. Provide the central pin (yoke pin) in the draft gear and shank connection.

7. Provide the base plate on the under frame with proper specified torque.
8. Remove the side locking pin of UIC linkage with the help of side pin puller.
9. Refit the uncoupling lever assembly on the coach with proper connection with the CBC shank.
10. Check CBC for proper working.

Tools Required

1. Torque wrench – 50 -220 Nm
2. Torque wrench – 135 – 675 Nm.
3. Sockets (Size – 24, 30 etc.)
4. Extension rod
5. Pneumatic impact gun
6. Lifting trolley
7. Hydraulic press 30 tons
8. Nyloc nut M 16 as per IS 700

Fixtures Required

1. Draft gear fixture.
2. Central pin – puller
3. Side pin – puller.
4. Taper pin.

5.6 PERIODIC MAINTENANCE & OVERHAULING

The following schedules shall be followed for Coupler assembly –

Position of coupler	Frequency
Coupled (in rake formation)	D1/Each trip/Weekly
Coupled (in rake formation)	D2/Monthly
Uncoupled	D3/ Six Monthly
Uncoupled (Single coach)	18 months (SS –I)
Dismounted from coach and disassembled	6 years (SS – III)

Maintenance Schedules and Action

Interval	Maintenance
Trip/Weekly Schedule	• Visual inspection of coupler head for damage. • Inspection of knuckle for damage. • Checking of coupler operating mechanism for damage/ loose bolts etc. • Greasing of glide rod of coupler operating mechanism (once in 3 months) • Checking of telltale recess, for ensuring proper coupling. • Inspection of coupler carrier/supporting device and its springs for cracks and breakage. • Inspection of loose / broken / missing nuts and bolts (M-16) of coupler pin support plate and draft gear support plate.
D2/ Monthly Schedule	All items of D1 • Visual check for external damage, condition of wear plate on shank. Replace wear plate if necessary. • Check height 187.5 mm both sides near the bolts. Tighten the M16 nut to set specified height. • Apply grease on wear plate. • Check condition of wear plate. Replace wear plate if necessary • Visual check for external damage, loose bolts etc. • Apply grease on the slide and slide rods
D3/Six Monthly Schedule	All items of D2 • Coat bare steel areas of coupler head body and knuckle with Molykote D321R (or equivalent) dry spray. **CAUTION: Do not spray on the knuckle locking surface and internal parts like lock etc.** • Check gap between coupler head and knuckle with Jaw gap gauge (NO-GO). If wear out is not acceptable replace knuckle etc., as advised in the maintenance manual. • Check by profile gauge (GO). • Conduct anti-creep check • Examine condition of buff plate. Apply grease if necessary • Check wear on slide, slide rods and bearings. Replace if wear is excessive.
Shop Schedule – I (18 Months)	In addition to item of Schedule – I, the following shall be attended during shop schedules - • Inspection of coupler assembly by gauges: - (a) Checking of knuckle contour by contour maintenance gauge. (b) Checking of free slack in the contour by contour condemning limit gauge. (c) Checking of distortion of aligning wing pocket and guard arm by aligning wing limit gauge and guard arm distortion gauge. (d) Checking of vertical height of aligning wing pocket and guard arm by vertical height aligning wing pocket and guard arm gauge.

Interval	Maintenance
	(e) Wear of aligning wing pocket and guard arm to be checked by vertical height condemning limit aligning wing pocket and guard arm gauge. (f) Checking of knuckle nose wear and stretch limit by knuckle nose wear and stretch limit gauge. • Inspection of anti-creep protection • Measurement of coupler height 1105 mm from rail level- Reference point – Vertical centre of knuckle or centre of shank • Checking of proper locking • Cleaning of CBCs • Checking of functional operation of coupler • Checking of operation of coupler operating mechanism Modification of locking screw as per RDSO"s drawing no. CG-K6036
Shop Schedule-III (72 Months)	All items of Shop Schedule – I • All parts of CBC and allied accessories to be dismantled and overhauled as per OEM"s manual. • Visual inspection be made for cracks, damages, distortions etc. • Checking wear of toggle, lock lift lever etc. • Checking of wear of coupler shank wear plate. • Checking for wear of lock of knuckle, pivot pin of knuckle and knuckle support pin. • Damage of draft gear rubber pads and its checking for pre-compression value. • Final assembly and checking of functional operation of coupler.

NOTE:

1. The following gauges are shop-issue –size gauges and not condemning gauges:
   i) Contour maintenance gauge
   ii) Contour condemning limit gauge
   iii) Aligning wing limit gauge
   iv) Vertical height aligning wing pocket and guard arm gauge
   v) Knuckle nose wear and stretch limit gauge
   vi) Vertical height condemning limit aligning wing pocket and guard arm gauge
2. The gauges should be procured from the OEMs of CBC.
3. As given in Para 8.2 of APTA RP-M-004-98, no painting should be done on any part or the assembly after overhaul except where specifically advised by RDSO.
4. Only dry lubrication as per Para 4.2 and 8.3 of RP-004-98 should be done in schedule III.
5. Reconditioning procedure of coupler should be followed as per Para 5 of APTA-RP-M-004-98. As mentioned in APTA-RP-M-004-98 Para 2.3. Knuckles, locks, knuckle throwers, knuckle pivot pins, rotary lock lift assemblies and Pivot pins should not be reconditioned.

5.6.1 Preventive Maintenance Procedures

(A) Coupler Assembly Inspection

1. Clean dirt/ grime from coupler assembly
2. Inspect to ensure that the train lines or other attachments do not interfere with coupler during operation. If piping or brackets are bent and out of alignment, straighten or replace.
3. Operate the coupler operating mechanism to ensure the knuckle (1) opens when the coupler-operating rod is raised to the top position.
4. Inspect the coupler body (10) sidewall and pin bearing bosses for cracks, broken sections or bent shank. If any damage is found, replace the coupler.

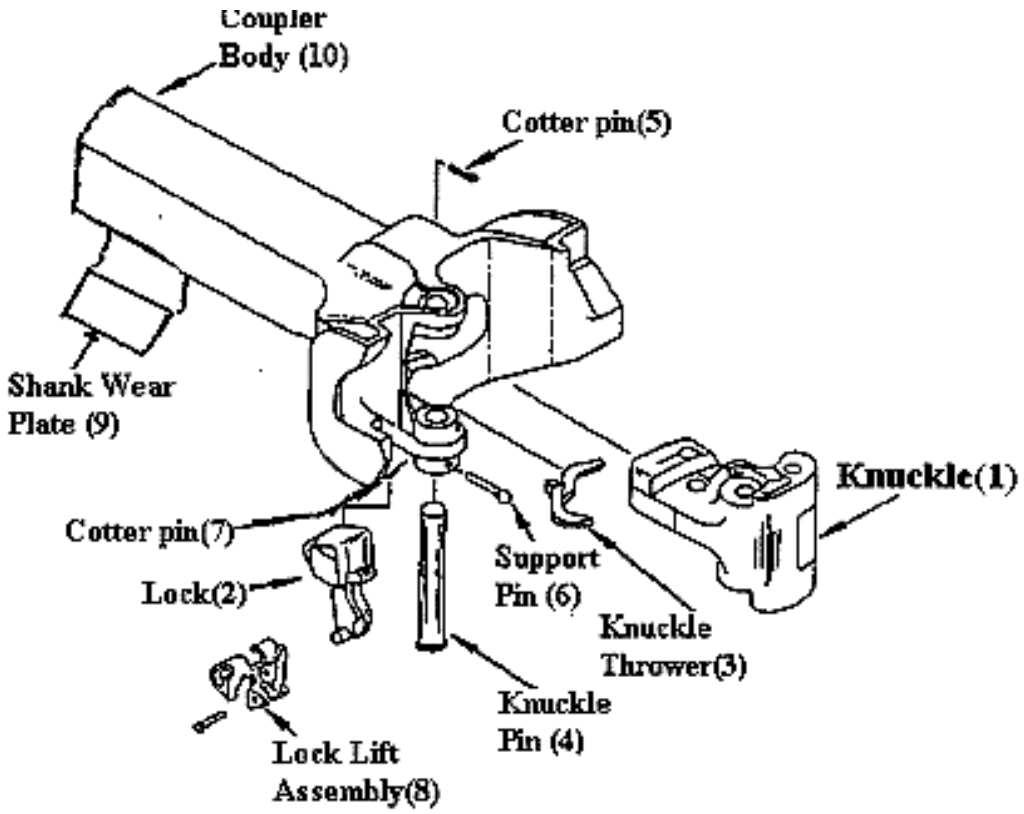


Figure: 5.7 Coupler Assembly Component

5. Inspect knuckle (1) pin bearing bosses and pulling face for cracks or broken sections or bent shank. If any damage is found, replace knuckle.
6. Check coupler shank wear plate (9) for wear. If shank wear plate is worn more than 3/16 inch, the coupler should be replaced.
7. Inspect support pin (6). Ensure cotter pin (7) is secure in support pin. Original diameter of the support pin is 5/8 inch, if worn more than 25% replace support pin and/or cotter pin. (Compare pin thickness to thinnest part of wear for estimate).
8. Inspect knuckle pin (4). Ensure cotter pin (5) is secure in pivot pin. If worn more than 25%, replace pivot pin and cotter pin. (Compare pin thickness to thinnest part of wear for estimate.) The pivot pin‟s original diameter is 1-5/8 inches.

(B) Shank (Coupler) Carrier Inspection

1. Clean dirt and grime from Coupler assembly.
2. Visually check to see if Couplers are resting on Coupler carriers. If not, inspect for the following -
   - Replace collapsed or broken Coupler carrier.
   - Low Car body height due to wheel wear or collapsed, weak or broken bolster and/or equalizer springs. If found, repair the damage, and re-inspect.
3. Check the thickness of wear plate. If needed, remove the wear plate from the support beam and add a new plate to the beam by welding
4. Check that the telltale recess (as shown in figure) is not obstructed. If found obstructed, look for defective uncoupling mechanism or broken lock. Replace damaged parts as necessary.
5. The lock must drop freely to the locked position when the knuckle is fully closed. The coupler is fully locked when the telltale recess is clear and unobstructed.

NOTE: Coupler must be coupled to other equipment to perform this inspection.

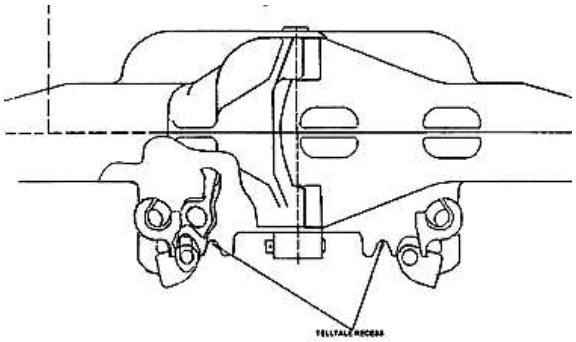


Figure: 5.8 Telltale Recess

(C) Lock lift Lever and Operating Rod Inspection

1. Inspect for bent or broken uncoupling mechanism. If uncoupling mechanism is broken, replace.
2. Check for proper operating rod eye clearance as follows:
   a. Close and lock the coupler and knuckle.
   b. Ensure coupler is centered in the carrier.
   c. Measure clearance between the rod eye and lock lift lever.
   d. Proper clearance should be 1/8 inch to ¼ inch.
3. If operating rod eye clearance is not correct, heat the coupler-operating rod to "cherry red" color and adjust with 2 pipe wrenches.
4. Check socket cap screw for free movement, if not break free and lubricate.
5. Check square tubing for smooth sliding from side to side, if not lubricate.

(D) Coupler Wing Limit Inspection

Aligning wing limit gauge (No. 32600 (APTA Gauge No.)

The aligning wing limit gauge is used to inspect for excessive distortion of guard arm of the coupler head as shown in figure.

The gauge must seat against the front face of the coupler head and the pivot lug and clear at all points around the interlocking lug guard arm face and lateral aligning surface. If the gauge does not seat or clear at the proper locations, there is excessive wear to the front face and pivot lug or distortion to the guard arm or interlocking lug. Remove and replace the coupler.

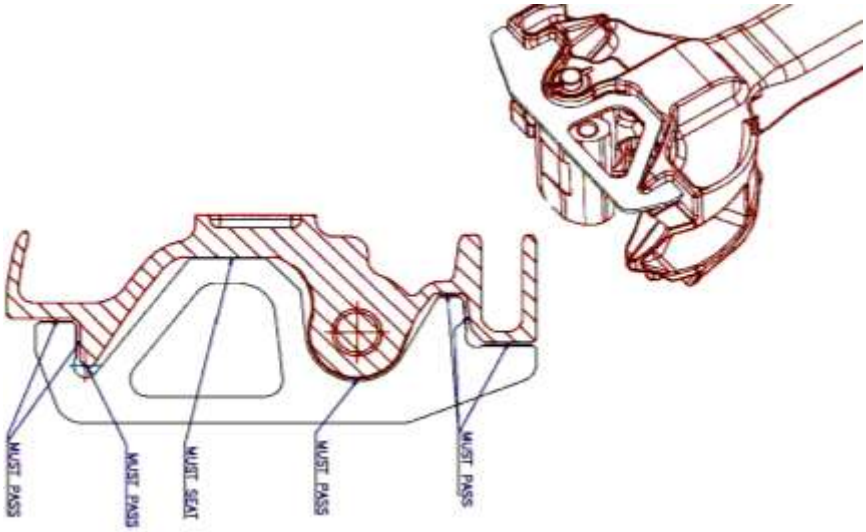


Figure:5.9 Aligning Wing Limit Gauge.

(E) Vertical Height Aligning Wing Pocket and Guard Arm Gauge (Go Gauge) 34101-4 (APTA Gauge)

The vertical height aligning wing pocket and guard arm gauge is used to inspect for excessive distortion and vertical height of Aligning Wing and/or Guard Arm of the coupler head, as shown in figure. The gauge must pass (slide into) the wing pocket and over the guard arm. If the gauge does not pass, there is vertical distortion to the wing pocket and/or guard arm. Remove and replace the coupler.

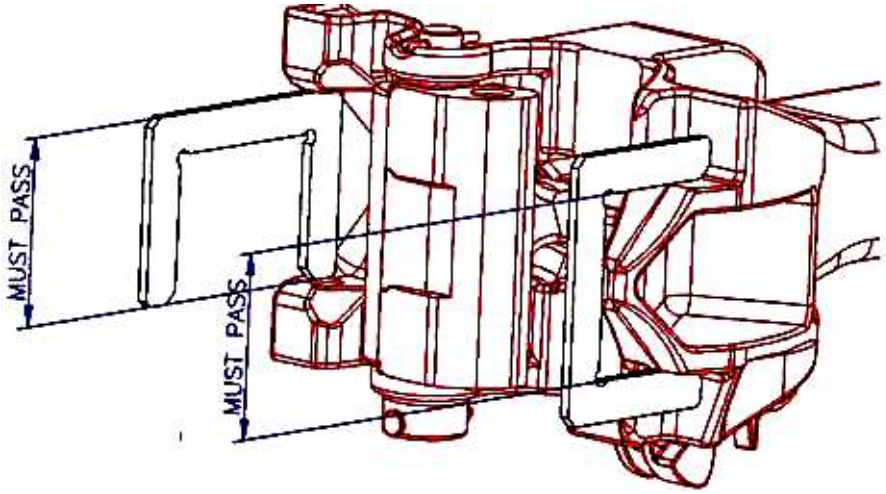


Figure: 5.10 Vertical Height Aligning Wing Pocket and Guard Arm Gauge

(F) Vertical Height Condemning Limit Aligning Wing Pocket and Guard Arm Gauge No. 44250-5(APTA Gauge)

The vertical height condemning limit aligning wing wear and Guard arm gauge is used to inspect for excessive distortion and vertical height of aligning wing and/or guard arm of the coupler head. The gauge must not pass (slide into) the wing pocket or over the guard arm. If the gauge does not pass, there is excessive wear on the interlocking surface of the wing pocket and/or guard arm. Remove and replace the coupler.

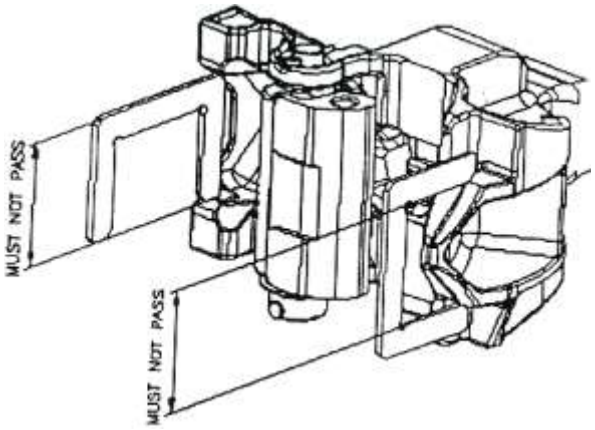


Figure: 5.11 Vertical Height Condemning Limit Aligning Wing Pocket and Guard Arm Gauge.

(G) Contour Maintenance Gauge No. 31000 (APTA)

This is a pass through gauge. The Contour maintenance gauge is used to inspect for correctness of contour. The gauge must pass through the contour with the knuckle fully closed and locked, with the gauge seated against the front face of the coupler head. If the gauge does not seat against the front face of the coupler, there is excessive wear to the front face of the coupler or a stretched knuckle. Remove and inspect the knuckle, using the Knuckle Nose Wear gauge.

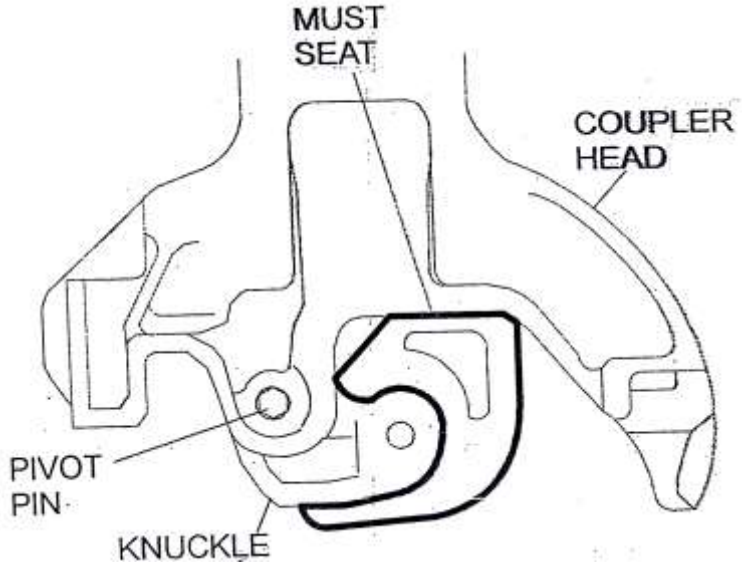


Figure: 5.12 Contour Maintenance Gauge.

(H) Knuckle Nose Wear and Stretch Limit Gauge No. 34100 -2A (APTA Gauge)

The knuckle nose wear and stretch limit gauge is shown in figure, Verify that points A, B, and C of the gauge seat on the knuckle and that point D does not touch or clear more than ¼ inch. If the points do not touch or clear properly, replace the knuckle.

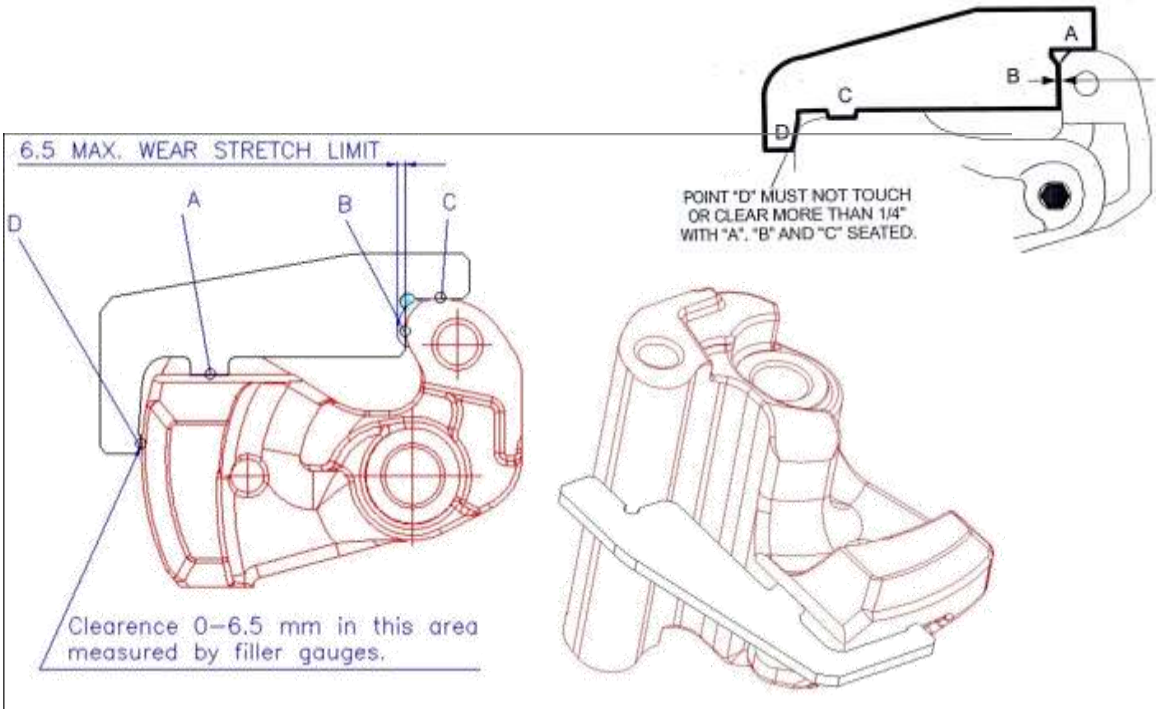


Figure: 5.13 Knuckle Nose Wear and Stretch Limit Gauge.

(I) Contour Condemning Limit Gauge No. 34100 -1 (APTA Gauge)

The Contour condemning limit gauge no. 34100-1 is used to inspect limit of contour slack (limit has been set at 3/8 inch). To inspect the limit of contour slack, close the knuckle and then pull slack of knuckle out toward you. The gauge must not pass between the front face of the coupler head and the pulling face of the knuckle. If the gauge does pass, remove the knuckle and inspect once more for wear. If the knuckle is worn, replace knuckle. While the knuckle is out of the coupler, inspect the knuckle pivot pin and pivot pin hole for excessive wear. If the knuckle pivot pin is worn, replace knuckle pivot pin. If the knuckle pivot pin and pivot pin hole are in acceptable condition, the lock could be worn and should be replaced. Also, the front face of the coupler could have excessive wear and should be replaced if found worn out.

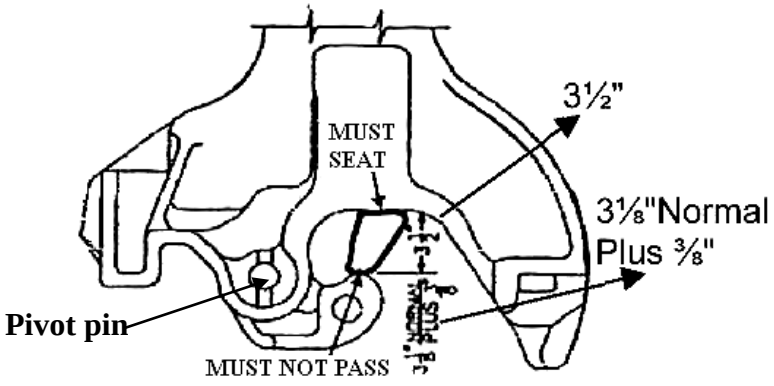


Figure: 5.14 Contour Condemning Limit Gauge.

(J) Lock on Knuckle Tail Shelf

To inspect lock on knuckle tail shelf, make sure the coupler lock is seated not more then 1/8 inch. above the knuckle tail shelf,(preferably seated on the shelf. See "S" in figure). If adjustment is necessary metal should be removed from guard arm (non tapered) side of lock by grinding preferably by machining. The amount of metal to be removed is 1/8 inch the distance the lock is to be lowered.

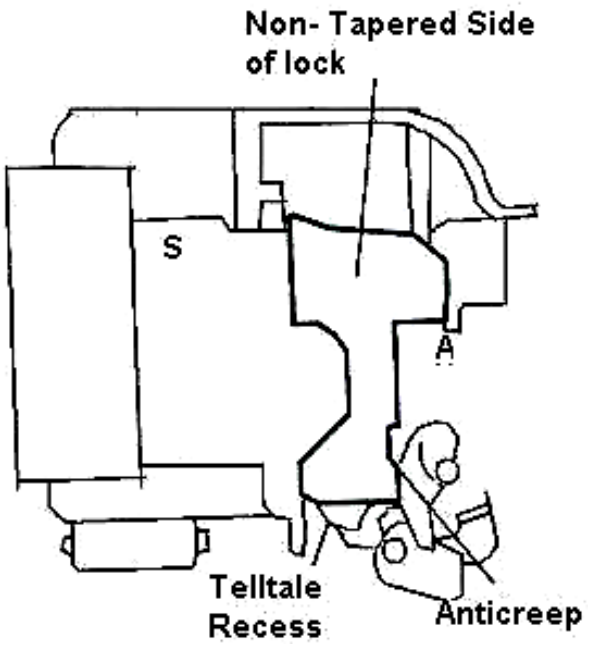
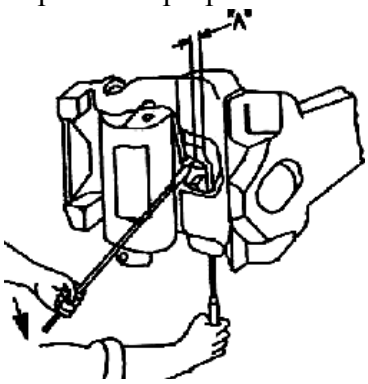


Figure: 5.15 Lock on Knuckle Tail Shelf

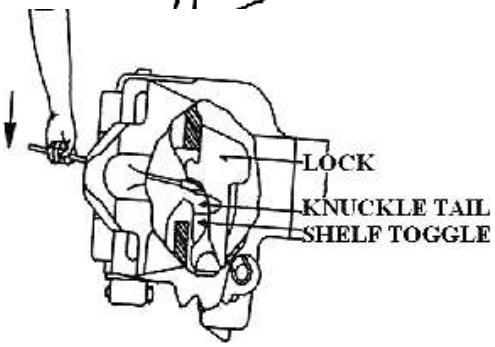
(K) Anti – creep protection inspection

Anti–creep protection is the front of overlap between the toggle and the anti–creep shoulder on couplers. Perform following steps to inspect for proper anti–creep protection:

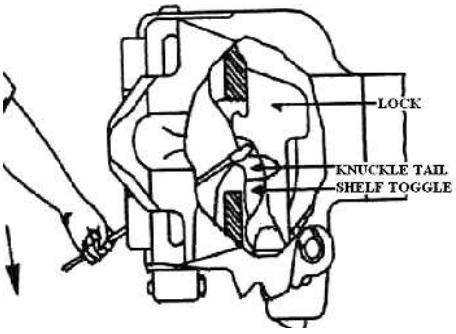
Step I. Inspection for anti–creep protection is made through the front of the coupler.



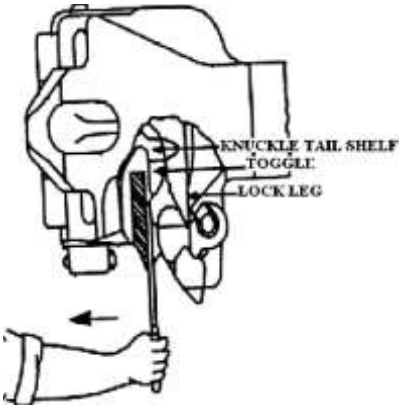
Step II. With the coupler in the locked position insert a pry bar through the front of the coupler between the knuckle tail shelf and lock, forcing the lock upward.



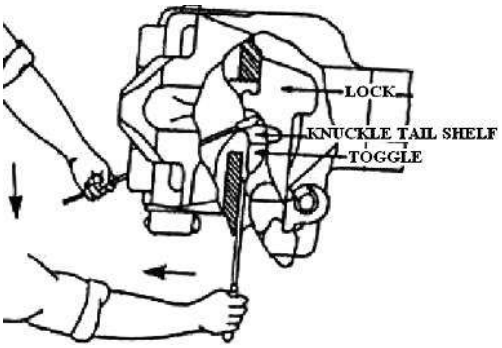
Step III. Forcing the lock upward as far as it will go engages the top of the toggle with the bottom of the knuckle tail shelf.



Step IV Insert a pry bar between the leg of the lock and the front of the lock hole. Pull toward the front of the coupler to force the lock leg rearward.



Step V. If the front edge of the toggle is 1/8" or more forward of the rear corner of the knuckle tail shelf the anti-creep is unacceptable; replace lock lift assembly.



Step VI. If an actual measurement is desired, inscribe a line on top of the toggle along the rear face of the knuckle tail shelf. Measure at point "C", the measurement must not be less than 3/8".

(L) Guard Arm Distortion Inspection

The guard arm distortion gauge is used to check distortion of the guard arm. To inspect for distortion of guard arm, the knuckle must be in pull position. When properly applied, the gauge must seat on the knuckle, and front of guard arm. The right side of the gauge must clear the right side of the guard arm. If the gauge does not clear the right side of the guard, the guard arm or pin protector boss is distorted or bent, and the coupler should be replaced.

(M) Procedure for building up the wear on coupler shank

The coupler shank is welded with a wear plate in the supporting area, made of manganese steel. This plate is the contact area of the coupler shank to the coupler support device. In case of wear, the worn plate can be removed and substituted by a new one.

(N) Coupler Height Inspection

If coupler are separated, inspect couplers to be maintained in a level position and at correct coupler height.

I. Check Levelness

(a) Suspend a weighted string against the machined front face of the knuckle when the coach is on a level track.

(b) Measure the distance from the front face of the knuckle to the string. The maximum distance should be not more than ¼ inch.

(c) To restore to level position, add shims on the coupler carrier if no other method of adjustment is provided in the shank carrier design.

(d) Excessive shimming should be avoided to maintain necessary vertical height of the coupler.

(e) When couplers are level, no shimming should be done at the carrier for coupler height.

II Check for Correct Coupler Height

(a) Coupler height should be 34 inches to 35 inches (34 ½ inches preferred). Reference coupler height center of coupler to rail (1105 mm) 43.5 inches.

(b) If the coupler height is too low, it could be due to worn, collapsed or broken coupler carrier springs. In addition, the car body height could be too low due to worn, collapsed, broken equalizer springs or bolsters, or extreme wear.

(O) Coupler Assembly Free Slack Measurement

Before inspecting the coupler assembly for free slack, first inspect the draft gear and yoke assembly to ascertain that no free slack exists in that assembly.

(a) Place Coupler Knuckle in locked position (coupled position). Ascertain that the Coupler is in the center of the Coupler carrier.

(b) Hold the Coupler knuckle and push the coupler toward the Coupler pocket. Measure the horizontal distance of the knuckle front face to a reference point on the end of the under floor.

NOTE: The measurement line must parallel to longitudinal centering of the coupler.

(c) Hold the coupler knuckle and pull the coupler out of pocket to the fullest range. Repeat the measurement. The difference between the two measurements is the amount of free slack in the coupler. Maximum of ½ inch free slack is allowed.

(d) If the maximum free slack is exceeded, the coupler pivot pin/bushing or knuckle support pin may have excessive wear. Refer to paragraph 5.6.1 (A) for inspection of the pivot pin/bushing or knuckle support pin and replace any worn components as necessary.

(e) If no excessive wear exists on the pivot pin or knuckle support pin but free slack still exists, replace the coupler.

5.6.2 Coupler height adjustment

Coupler height shall be adjusted by adding or removing shims from the bottom of the coupler carrier assembly when the vehicle is empty and at rest on a level track.

(A) Increasing coupler height

1. Using a jack, support the head of the coupler.
2. Elevate the jack to raise the coupler to proper height. Coupler height of center of coupler to rail is 1105 mm.
3. Clean all dirt and debris from coupler shank, Coupler shank wear plate and Coupler (shank) carriers.
4. Measure the gap between the top of the coupler carrier and the bottom of the coupler shank wear plate.
5. Select a combination of shims that most closely equal the gap measurement.
6. Loosen coupler carrier bolts located at the front of the coupler carrier.
7. Inspect the wear of the coupler wear plate. The original thickness is ¼ inch. If wear plate is reduced to 1/16inch.it shall be replaced.
8. Inspect the wear on the coupler earner wear plate. The original thickness is ¼ inch. If wear plate is reduced to 1/16 inch. It shall be replaced.
9. Using a pry bar. Pry the coupler carrier up to support the correct coupler height.
10. Insert the shim or the shim between the coupler carrier and the striker support from the front of the striker.
11. Tack weld shim or shims to striker support.
12. Retighten coupled Coupler bolts.
13. Lower the jack until the coupled shank wear plate is supported by the coupler carrier.
14. Inspect the coupler carrier height center of coupler to rail is 1105 mm.

(B) Decreasing Coupler height

1. To determine the distance by which the coupler should be lowered. Subtract the required coupler height (34 ½ inches plus or minus ½ inch) from the actual measured coupler height. Reference coupler height from center of coupler to rail is (1105 mm) 43.5 inches.
2. Loosen coupler carrier bolts located at the front of the coupler carrier.
3. Inspect the wear on coupler wear plate.
4. Inspect the wear on the coupler carrier.
5. Using a pry bar, pry the coupler carrier up.
6. Remove tack weld to remove shims.
7. Tack weld shim or shims to striker support.
8. Retighten coupler carrier bolts.
9. Lower the jack until the coupler shank wear plate is supported by the coupler carrier.

10. Inspect the coupler carrier height; center of coupler to rail is 1105 mm.
11. If coupler remains too high after all shims are removed. Inspect for damage to coupler carrier, coupler shank or car body.

5.6.3 Repairs – (please refer to fig 5.10)

(A) Support pin replacement

1. Straighten legs of cotter pin (7).
2. Remove cotter pin (7) from support pin (6) and discard used cotter pin.
3. Push up and hold knuckle pin (4) to relieve weight on support pin.
4. Remove support pin (6) and discard.
5. Insert new support pin (6). Inspect to ensure cotter pin hole is visible beyond the back edge of the knuckle pin lug on the coupler body.
6. Release knuckle pin (4)
7. Insert new cotter pin (7) through hole in support pin (6)
8. Spread legs of cotter pin (7) to secure.

(B) Knuckle pin replacement

1. Using a jack, support the weight of the knuckle (1).
2. Remove cotter pin (7) and support pin (6).
3. Straighten legs of cotter pin (5)
4. Push up and hold knuckle pin (4).

   WARING: The knuckle is free to move when the knuckle pin is removed. Exercise extreme caution that the knuckle is not moved before knuckle pin is installed.
5. Remove cotter pin (5) from knuckle pivot pin (4).
6. Lower knuckle pin (4) through the pivot pin hole of the coupler and the knuckle.
7. Insert new knuckle pivot pin (4) in coupler and knuckle.

   NOTE: The pivot pin must be inserted from the bottom of the coupler with the cotter pin hole visible above the top of the coupler head.
8. Insert new cotter pin (5) and spread cotter pin legs to secure.
9. Push up on pivot pin (4) and hold.
10. Install new support pin (6) and cotter pin (7).

(C) Replace knuckle

1. Verify that the knuckle (1) is closed and locked.
2. Using a jack table, support the weight of the knuckle.
3. Remove knuckle pin (4).
4. Slide knuckle (1) forward until it is free from coupler body (10) and fully supported on jack table.
5. Discard old knuckle (1)

6. Place new knuckle (1) on jack table and position at coupler body (10).
7. Slide knuckle (1) into opening between knuckle pin lugs in coupler body (10)
8. Use draft pin to align pivot pinholes on coupler body (10) and knuckle (1).
9. Install new knuckle pin (4), new support pin (6), and new cotter pin (5 and 7).
10. Spread legs of cotter pins (5 and 7) to secure.

5.6.4 Coupler Assembly Overhaul

Coupler assembly should be completely overhauled during Shop Schedule –III (6 Years) in accordance to OEM"s instructions.

5.6.5 Troubleshooting

For trouble shooting, respective Maintenance manual/ OEMs Maint. Manual should be referred.

5.7 TOOLS AND ACCESSORIES

Handling of major subassemblies requires availability of one or two overhead traveling cranes of sufficient lifting capacity, lifting straps and trestles. Other special tools and aid required for maintenance are mentioned below.

Standard Tools and Aids such as:-

- Screw drivers
- Fitters Hammers (500/1000 grams)
- Chiesels
- Set of wrenches
- Set of ring wrenches
- Set of Hexagon Socket Screw Key
- Torque Wrenches for 73 Nm
- Torque Wrenches for 510 Nm
- Torque Wrenches for 690 Nm
- Set of Drift Punches
- Thickness Gauges
- Pillars for retaining rings

Standard Materials

- Compressed air (oil free)
- Cleaning Rags
- Paint Brushes
- Grease
- Non resign penetrating oil
- Pocket lamp

- Rope
- Bubbles label
- Steel rule
- Key alignment gauges
- Preloading press
- Friction spring mounting device
- Universal reversal ratchet size ½ inches
- Lifting apparatus for – 0.5 tons
- Primer

5.8 RECONDITIONING PROCEDURE

Please refer to OEMs manual for reconditioning procedure.

Note:

A. 1. For Para 5.5.6 Refer Maintenance. Manual of Faiveley

2. For Para 5.6 to 5.6.3 Refer Maintenance Manual of M/s ASF- Keystone

B. Above guidelines is for references. Presently components of CBC of different makes are not interchangeable and design is different. As of now CBC of two new manufacturers" M/s Escorts and M/s Dellner are in the service. In such situation, the maintenance manual of OEM and CMI issued by RDSO for CBC are important to be followed for maintenance.

A. The General Guidelines for Coupling of CBCs between Coach to Coach or Locomotive to Coach

1. Ensure that coaches to be coupled together are dead stopped at a distance of 1-2 meter from each other. In case of coupling with locomotive, it should be 2-3 metre. The first five coaches or remaining portion of the standing rake should be in braked condition.

2. Ensure that manual uncoupling operating rod handles of coupling end of both the vehicles are unlocked.

Unlocked uncoupling Device handle

3. Align the two couplers to bring them in the gathering range.

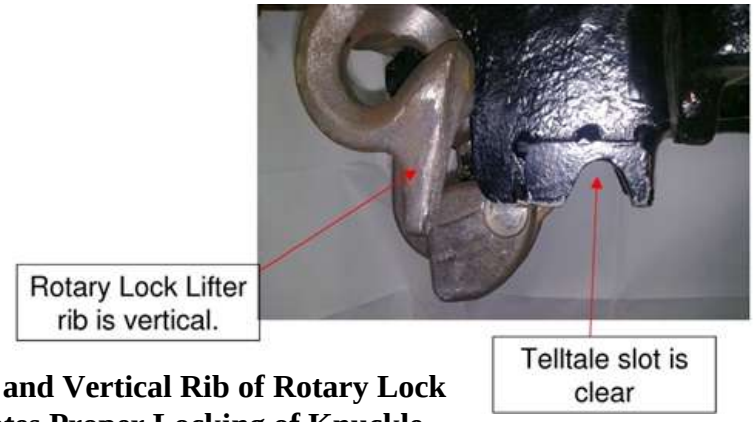
4. Ensure knuckle of at least one of the coupler is open. Coupling can take place when knuckle of only one of the coupler is open or knuckles of both the couplers are open. When coupling with locomotive, knuckle of locomotive should be preferably opened. However, when situation demands more gathering range knuckles of both the couplers may be opened.

The operating rod handle of the manual uncoupling device must be raised to the top position to open the coupler. Raising the handle disengages the coupler lock and actuates the knuckle to the open position.

Knuckle in Open Condition

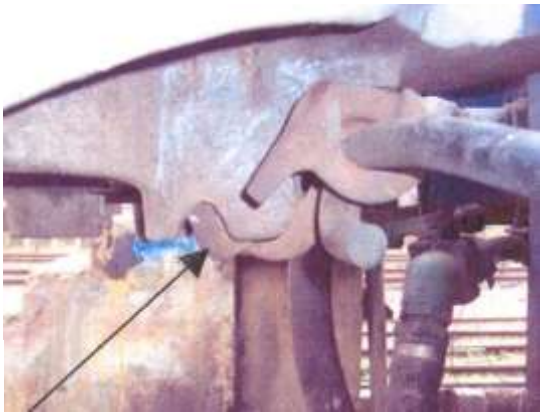
5. Speed at the time of coupling should be 2 to 3 kmph. This speed is high enough to ensure that the lock lift lever is completely dropped. The coupler will automatically lock.

6. Ensure that the lock lift levers of both the couplers are completely dropped.



Clear Telltale Slot and Vertical Rib of Rotary Lock Lift Lever Indicates Proper Locking of Knuckle

Note: It is possible that knuckles are locked but the lock lift lever is not fully dropped. This situation is the most dangerous as it gives false indication of coupler locking. The coupler may open during run. Ensuring complete dropping of lock lift lever is important. However, such incidence of partial locking of coupler should be taken very seriously and it should be put on record with details of coupler particular and should be advised to RDSO.



Telltale Slot not Clear and Rotary Lock Lift Lever Rib not Vertical Indicates Partial Locking of Knuckle

7. Adequate lighting should be provided to ensure that couplers are properly coupled. RDSO has issued an instruction of a marking scheme of painting lock lift lever with bright yellow paint of approx. 2" dia. The details have been covered in section D.

8. Ensure that manual uncoupling operating rod handles of both the vehicles are locked after fully locking of couplers.

Manual Uncoupling Handles in Locked Condition

9. The coupler must be checked for proper locking by pulling these couplers (by pulling loco forward).

B. The Guidelines for Coupling of CBC Equipped Coach with Locomotive

The following procedure order should be adopted for a coaching train fitted with CBC:

1. After berthing the CBC rake on the platform and before releasing the rake by C&W, the first five coaches should be in braked condition.
2. For attaching the locomotive, the loco shall be stopped at 20 meters from the first coach and shall move slowly to again stop at not less than 3 meters from first coach of the rake.
3. The SLR CBC and loco CBC shall be aligned horizontally so that they are within gathering range. The gather range of „E" type coupler is 80 mm and in case adjoining coupler heads are offset by more than this, they need manual alignment.
4. SLR CBC knuckle shall be normally in the closed position and ensure full clearance of tell tale recess. The loco CBC knuckle shall be unlocked and in open condition.
5. The loco pilot shall proceed the loco up to the 3rd notch in succession so that the loco can couple with the coach at a speed of 2 to 3 kmph.
6. On coupling, full clearance of tell tale recess of both couplers shall be ensured by C&W staff. C&W staff after ensuring that both the couplings are in place shall lock uncoupling rod by putting locking screw in place.

7. The training of all the loco pilots, concerned C&W and operating staff shall be arranged. A dedicated training session on correct procedure of coupling the CBC rakes and how to ensure proper locking should be part of the training Loco pilots should be made responsible for checking proper locking of CBC of 1st coach with locomotive. Till all concerned staff are trained, C&W staff may be deputed to escort the train.

8. In case locomotives are not fitted with „H" type AAR coupler head, a vertical restrictor should be provided in CBC of front end of first vehicle. A new vertical restrictor design has been finalised (RDSO Sketch No. CG-10063). The new vertical restrictor restricts the vertical movement in both the direction (Up & down).

Vertical Restrictor to be Provided in the First Vehicle

9. In case locomotives are not fitted with „H" type AAR coupler, difference in height of locomotive knuckles and that of Generator van/ SLR should be checked by TXR with a gauge as prescribed in RDSO letter no. MC/BLB/CBC dated 26.07.2010. This gauge should be used by TXR to check before departure of train. By application of this gauge, the adequate overlap between loco knuckle and coach knuckle can be ensured to prevent uncoupling between the loco and Generator van/ SLR.

Procedure of Using the Gauge

When the Loco Knuckle is below the Coach Knuckle

In this case, the gauge should not be used.

When the Loco Knuckle is above the Coach Knuckle

Washer should be placed on the top of the loco knuckle and the bolt should be allowed to go down. The gauge should be kept in such a way that the washer rests evenly on the top of the loco knuckle and the lower end of the bolt touches the top of the coach knuckle. In this position, it should be seen that the mark provided in the centre of the bolt is above the washer. If the mark is not visible above the washer, the generator van should be unloaded till such time the centre mark is visible above washer.

Gauge for measuring difference in height of coupler

Note: It should be noted that this gauge should not be taken as a measure of minimum buffer height of 1030 mm as per IRCA rules. To ensure this stipulation, the extant instructions shall be followed.

10. The loco pilot shall take the 2nd notch for checking the proper coupling by pulling the rake. The C&W staff shall insert the shim.

11. When the loco is in the pulled condition, the gaps in the CBCs shall be filled by providing shims of adequate thickness by the C&W staff. The shims shall be tied with wire to the restrictor plate.

12. The loco pilot and guard shall ensure that the required amount of BP and FP pressures are built up in loco and SLR respectively.

13. After ensuring the above procedure for coupling, the brakes of first five coaches shall be released by C&W staff.

14. The CBC of the coaching stock should be maintained as per RDSO"s Maintenance Instructions No. RDSO/2006/CG/CMI-01 revision 1 dated 29.07.2010. The loco CBC should be maintained as per RDSO"s Technical Booklet no.G-76 and Bulletin No.MP.IB.LD.01.17.10 (Rev.00) Dated 07.04.2010 (para 6.1.5). However, para 4 above will supersede para 6.1.5 of the technical bulletin.

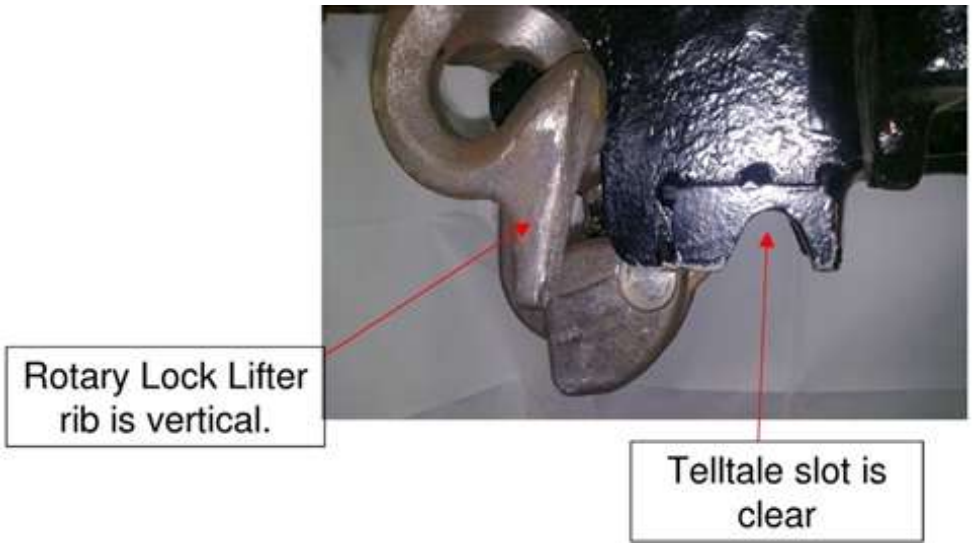
C. Check points for CBC Coupler to ensure proper Coupling

Following points must be checked to ensure proper coupling:

Coupled Conditions:

Check Point 1: Telltale slot should be clear of Rotary Lock Lift Lever

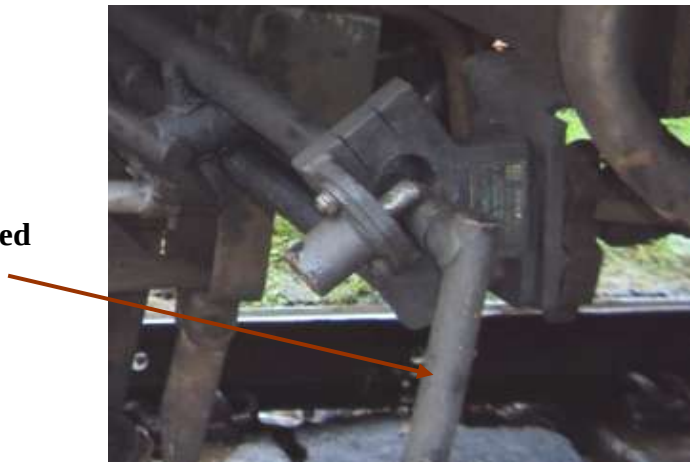
Check point 2: Rotary Lock Lifter rib should be vertical.



Clear Telltale Slot and Vertical Rotary Lock Lift Lever Indicates Proper Locking of Knuckle

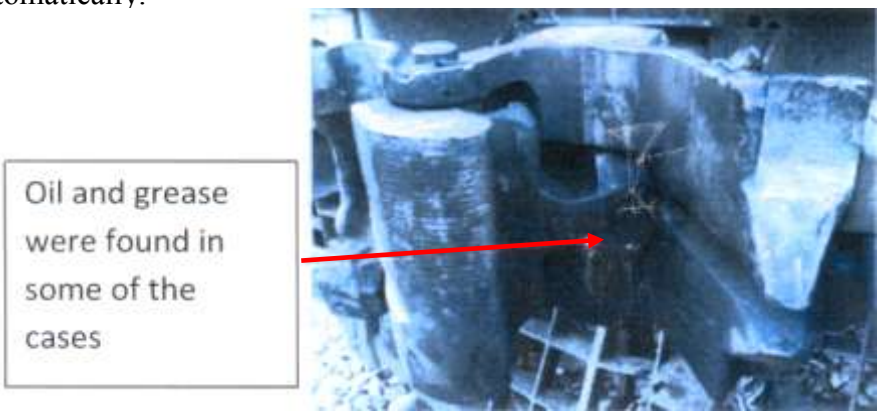
Check point 3 : Locking screw of Manual Uncoupling Device should be in locked condition. This is to prevent manual uncoupling inadvertently.

Uncoupling Device Operating Rod Handle cannot be Operated

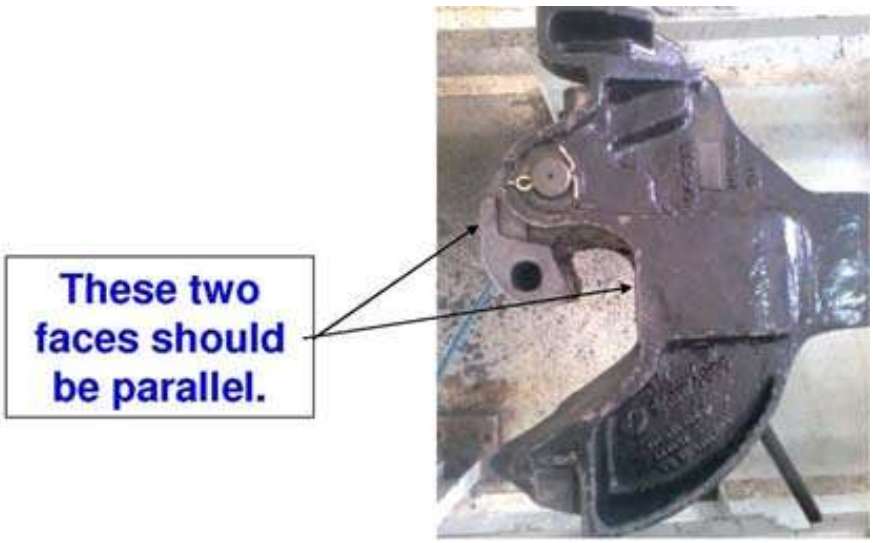


Following points should be checked before coupling

Check Point 1 : No oil or grease should be applied on the coupler internal parts such as Knuckle, Lock, Rotary Lock Lifter etc., Oil and grease on the coupler internal parts can cause the Lock to slide and lead to uncoupling automatically.



Check Point 2 : Knuckle and Coupler Head machined faces should be parallel when knuckle is in closed condition. This can be examined visually.



Position of Knuckle in Closed Condition

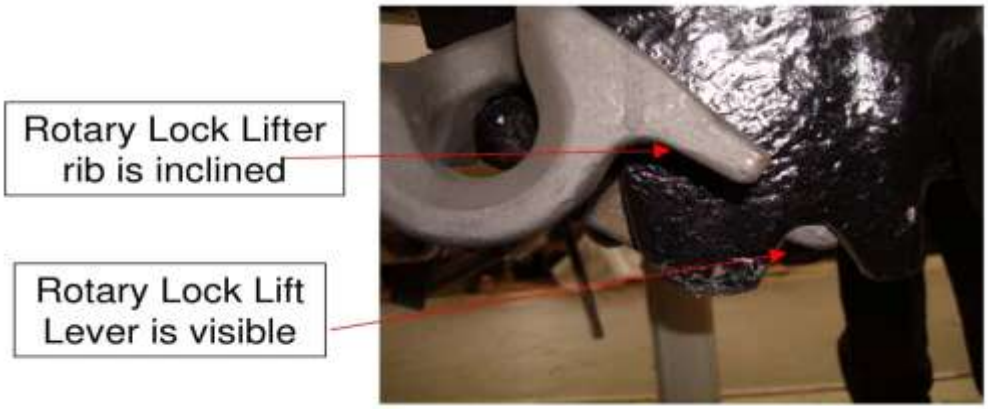
Uncoupled Conditions:

Check point 1: Securing Bolt should be in unlocked condition. Uncoupling Device operating rod handle can be operated to uncouple.

Unlocked uncoupling Device handle

Check point 2. Rotary Lock Lift Lever should be visible in tell tale slot.

Check point 3. Rotary Lock Lifter rib should not be vertical.



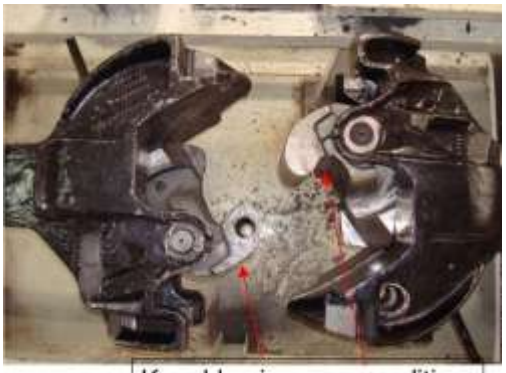
Position of Rib of Rotary Lock Lift

Check point 4: The Knuckle and Coupler Head machined faces should not be parallel.

Knuckle in Open Condition

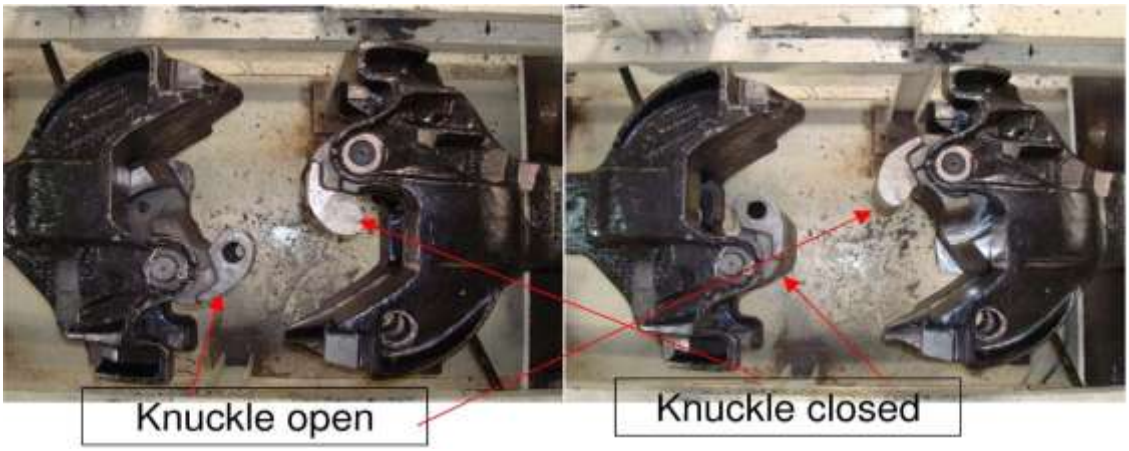
Coupling is possible under any of the following conditions

a. When both Knuckles are in open condition



Both Knuckles are in Open Condition

b. When one knuckle is open & the other is in closed condition



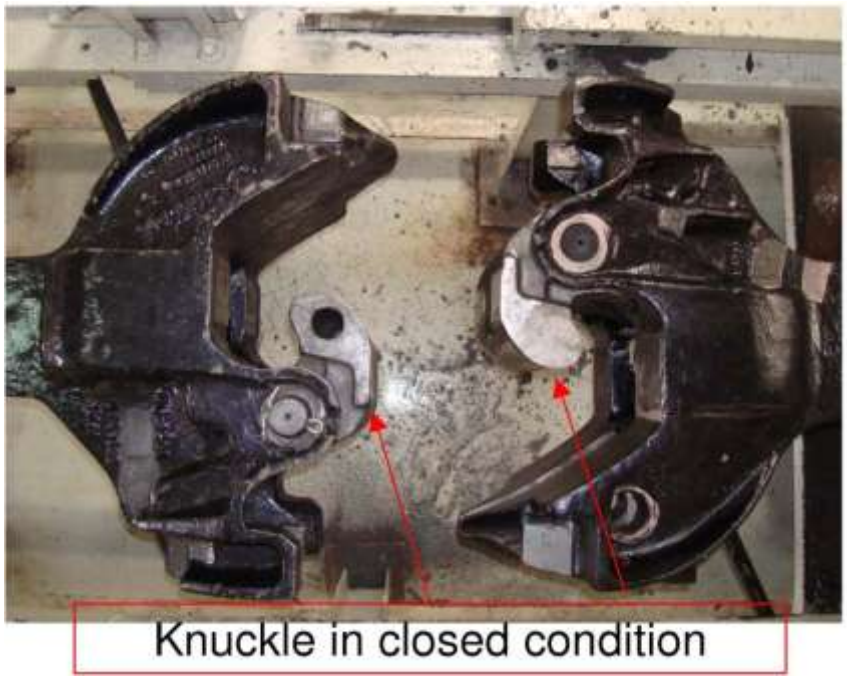
Only one knuckle in Open Condition

c. Couplers are coupled

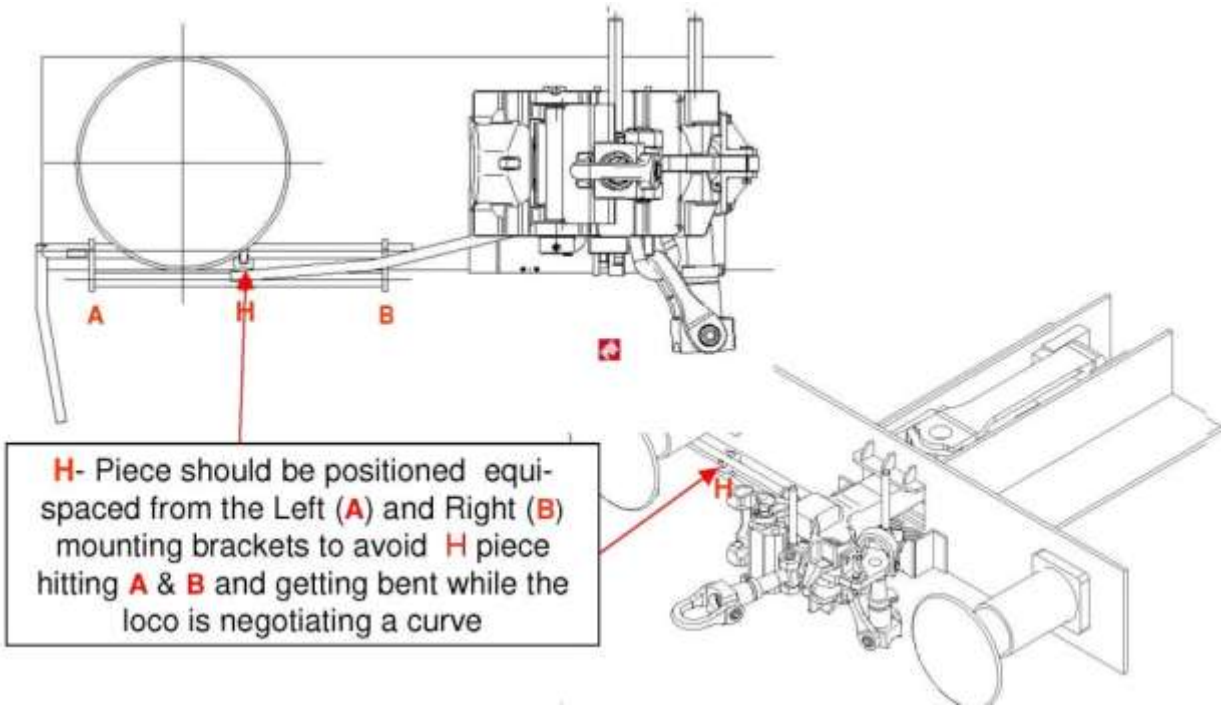
However, for coupling first coach with locomotive, SLR CBC knuckle shall be in the closed position as advised in para - 4 of section A. For coach to coach coupling, coupler head of one of the coach shall be preferably in closed condition.

Conditions that will not permit coupling

1. If both knuckles are in closed condition coupling will not take place

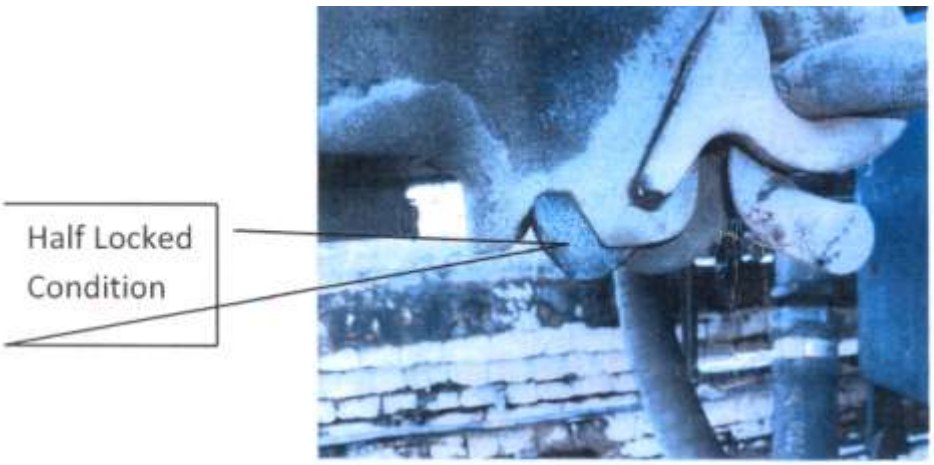


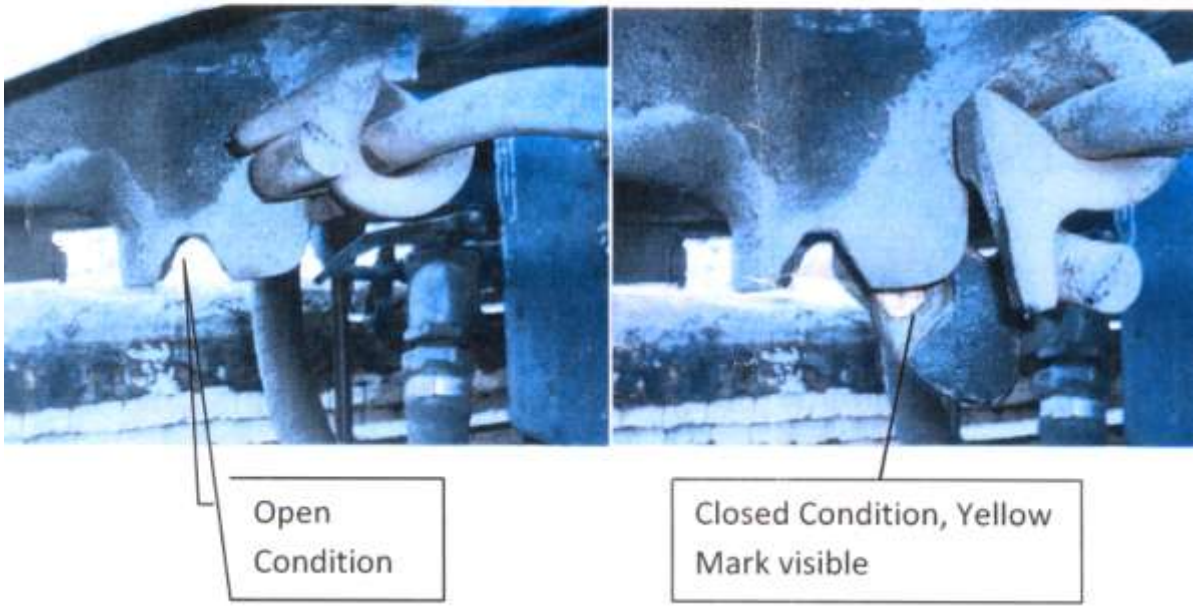
Manual Uncoupling Device



D. Marking Scheme of Lock Lift Lever

Adequate lighting should be provided to ensure that couplers are properly coupled. Lock lift lever in working condition has dull dark colour and its position is difficult to ascertain when there is inadequate light. RDSO has issued a scheme of marking lock lift lever with bright yellow paint of approx. 2" dia to improve visibility. Position of yellow marking should be such that it is just visible when lock lift lever is fully dropped.





E. Points to be Checked in the Event of Train Parting

1. Train no. and name
2. Primary maintenance depot of the train.
3. Section and location of train parting.
4. PRO particulars of the coach involved.
5. Make of CBCs involved in train parting.

6. In case, the train parts between loco & coach,

   i. Schedule particulars of the locomotive along with base shed should be indicated.

   ii. Type of locomotive coupler head, whether it is „E" type or „H" type. iii. Height CBC (Centre) of coach from rail level loaded and unloaded

   condition.

   iv. Height CBC (Centre) of locomotive from rail level loaded and unloaded condition.

   v. Vertical restrictor provided or not.

   vi. Whether checking for overloading of SLR/ power car was done at originating station with the gauge as prescribed vide RDSO"s letter no. MC/LHB/Coach dated 26.07.2010.

   vii. At the time of last coupling, whether knuckle of SLR/ power car coupler was opened or knuckle of locomotive coupler was opened or knuckle of both the couplers was opened.

   viii. Last station in which the loco was coupled

7. Locking status of knuckles of both the CBCs involved in train parting, whether knuckles were found locked or open.

8. Position of lock lift lever of CBC in which knuckle was found open, whether the lock lift lever was fully or partially dropped.

9. Locking status of manual uncoupling rod, whether it was locked.

10. Details of modification in the CBCs involved in train parting.

11. Photographs to be taken of CBCs indicating position of lock lift lever, telltale sign, relative difference in buffer heights etc.

12. Topography (index plan) of the section involved where train parting took place. Condition of track like presence of low joint, curvature etc.

13. Statement of driver, guard, operating staff and officer who attend to the train parting.

14. Operating features like caution order, emergency braking or any other prima-facie reason which could contribute towards train parting.

15. Any other factor which could have contributed towards opening out of CBC.

16. Whether any difficulties were observed at the time of coupling?

All the concerned staff/ officers should be made aware of this check list. Railways are advised to follow the above check list in recording the incidents of train parting and report to RDSO.

5.9 SIDE BUFFER ASSEMBLY FOR POWER CAR

The modified Loco Side Buffer (B.G.) as per R.C.F. drg. No. M1004277 is used on LHB Coaches along with CBC.

Buffer assembly and its components meet the requirements of RDSO Spec. no. MP 0.41.00.02, which is the standard specification for the Loco Side Buffer Assembly.

The General Arrangement of this Buffer shall confirm to RDSO drawing. No. LA/ BD – 153/M (Alt – Latest) except the mounting holes on the base of buffer casing, overall length of Buffer and shape & size of Face Plate.

The Face Plate of side Buffer shall be as per drawing no. LP 22/02 and LP 22/03 for LH & RH. Respectively.

Periodic Maintenance

Side Buffer Assembly should be examined for cracks / damages and/or corrosion during trip schedule. Check for tightness of buffer fixing bolts, drooping of buffers and slackness on buffer plunger.

Buffer force should be scrubbled with a scrapper to remove dirt and muck and wiped clean using cleaning fluids. After cleaning, the buffer force should be checked for condition of CSK rivets holding face plate. Apply graphite grease on face plate after checking for cracks and wear.

Projection of buffer from head should be within 600 mm to 635 mm.

Shop Schedules

Side Buffer assembly should be completely overhauled during shop schedule II (36 months).

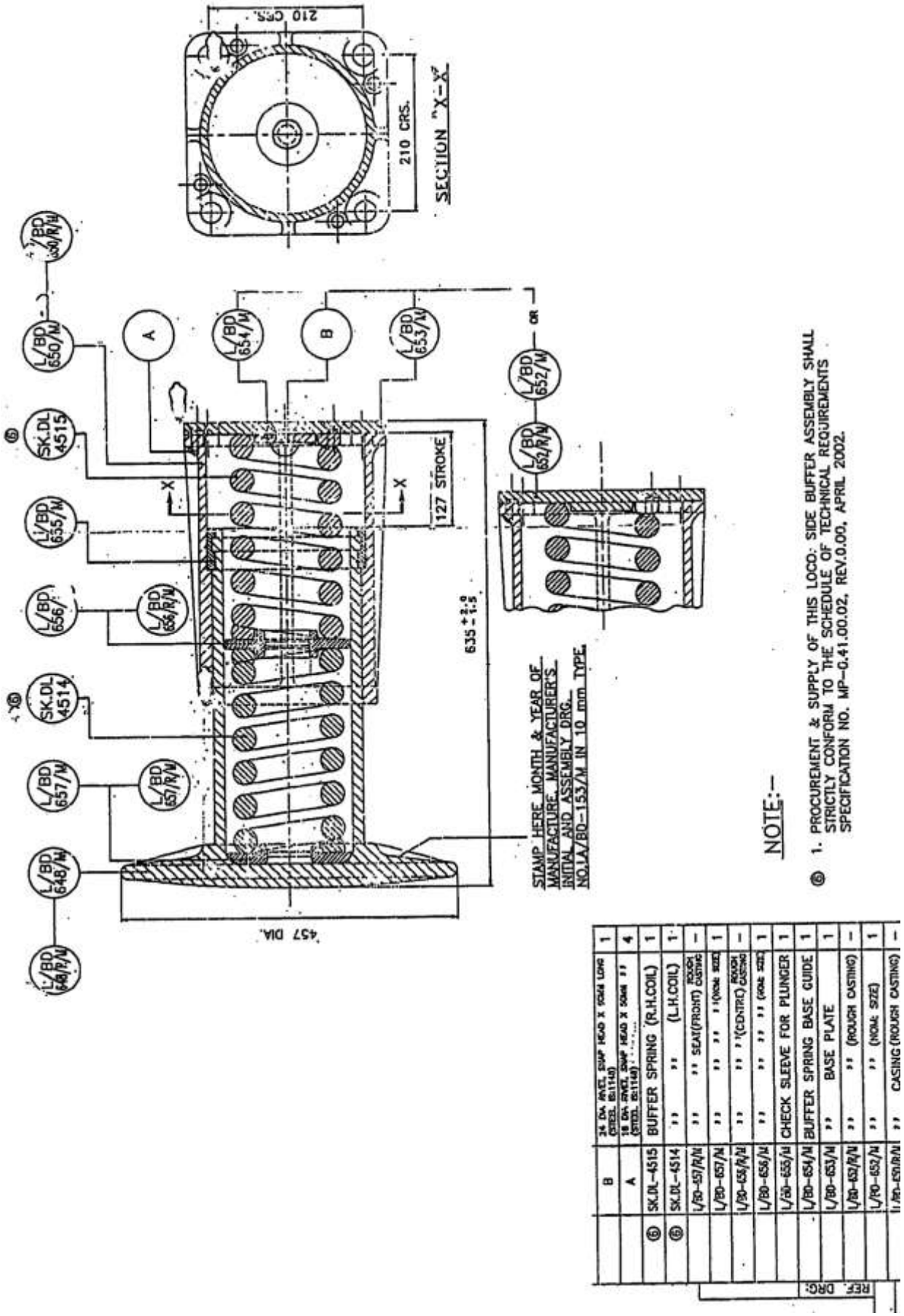


Figure: 5.16 Side Buffer Assemblies for Power Cars

NOTE

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AIR CONDITIONING AND TRAIN LIGHTING

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CHAPTER 6

AIR CONDITIONING AND TRAIN LIGHTING

6.0 END ON GENERATION (EOG) SYSTEM

End on generation (EOG) system envisages providing power car in front and rear end of a rake for coaches for power requirement in between them. These coaches are equipped with 60 kVA step down transformers for stepping down 750 V, 3 Φ AC, 4 wire, 50 Hz supply to 415 V, 3 Φ AC, 4 wire, 50 Hz supply. The 750V supply is fed to entire rake through two feeders running on both sides of coaches along the full length of rake. Power cars at both ends take entire load of whole rake, which includes air conditioning, light and fan circuit, and emergency battery charger circuit and pantry equipment. This system is provided in Rajdhani/ Shatabdi/ Duronto/ Garib Rath LHB type trains. Each power car has two DG sets, out of which one DG set is standby.

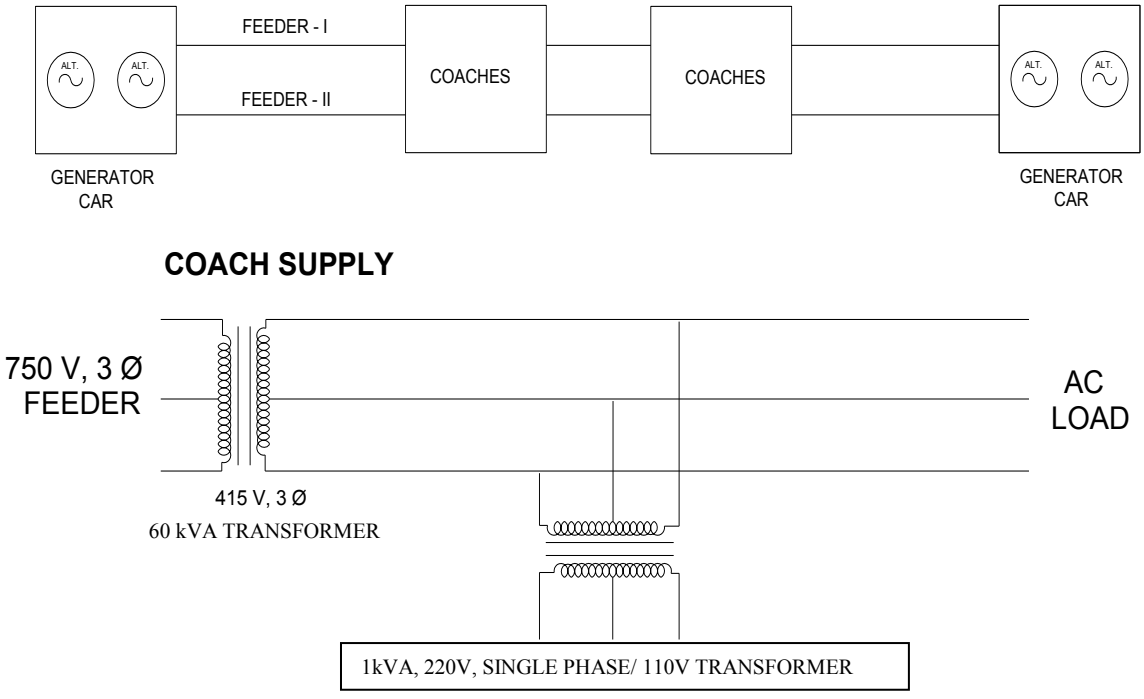
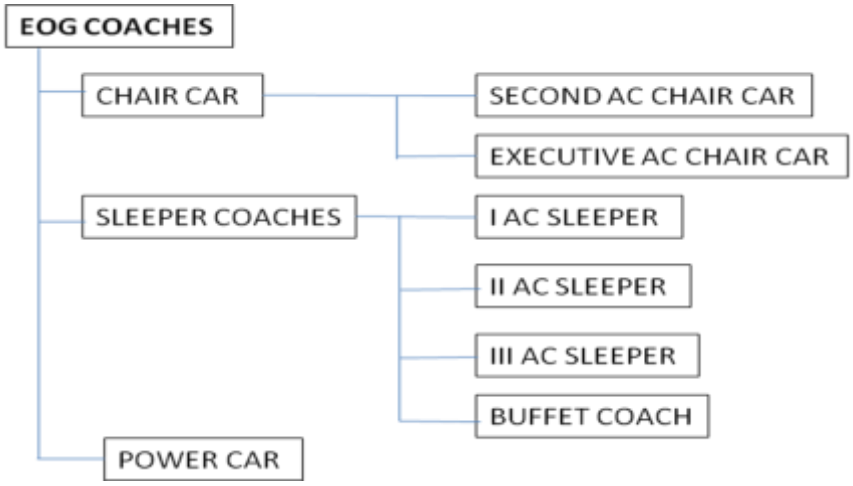


Figure 6.1 End ON Generation System

6.1 LHB TYPE EOG AC COACHES

These new generation passenger coaches have better parameters of passenger comfort, safety and reliability. The End on Generation (EOG), Linke Hoffmann Bosch (LHB) variant AC coaches can be broadly classified into AC sleeper coaches and AC chair cars as given below.



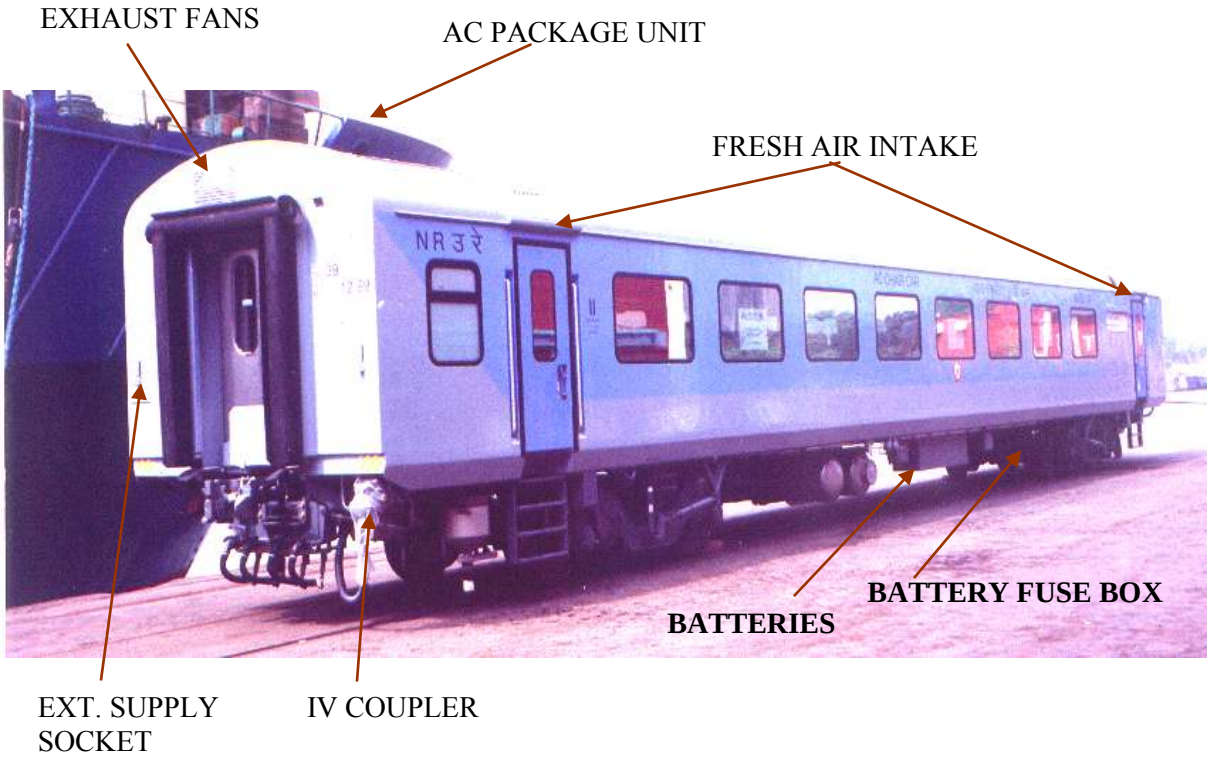


Figure 6.2 Electrical Features of LHB EOG Coaches

6.1.1 Codes of Different LHB Coaches Over Indian Railways

SN	Code	Type of coach
1	LWFAC	First AC EOG LHB
2	LWGACCW	AC 2 Tier SG LHB
3	LWACCW	AC 2 Tier EOG LHB
4	LWGACCN	AC 3 Tier SG LHB
5	LWACCN	AC 3 Tier EOG LHB
6	LWFCZAC	Executive AC chair car EOG LHB
7	LWSCZAC	AC Chair Car EOG LHB
8	LWCBAC	AC Pantry Car LHB
9	LWLRRM	Generator Car LHB

6.1.2 Electrical Features of LHB EOG AC Coaches

- IGBT based battery charger.
- Micro-controller based Roof Mounted Package Unit (RMPU) for Air Conditioning.
- Microprocessor based pump controller unit.
- Integrated, modular single Switch Board Cabinet with controls of AC, lighting & pantry etc.
- Provision of Dry type Transformer without encapsulation
- Modular and elegant interior light fittings and reading lights.
- Integrated modular pantry unit.
- Provision of electron beam irradiated cables.
- Provision of Measuring and Monitoring relays in Feeder circuit
- Online insulation monitoring.
- Uniformity of illumination.
- Wheel set earthing equipment for high life of axle bearings.
- Provision of earthing and disconnecting device.
- Cable protection system with IP-67 protection and UL-94 V0 fire retardancy.
- Screw less, modular elegant switches.
- Provision of Emergency Battery charger

6.2 DESCRIPTION OF COACH EQUIPMENT

These coaches are equipped with the following equipments:-

6.2.1 Switch-Board Cabinet- S1

Coaches are provided with modular, integrated single cabinet designated switch board cabinet comprising all necessary equipments for control and protection of following coach systems:

- Microprocessor based Heating, Ventilation & Air conditioning
- Lighting
- Pantry
- Anti skid protection
- Public Address system
- Sanitary system (except W.C. control)
- Regulated IGBT based Battery charger
- Disconnecting and Earthing device.
- On-line insulation monitoring relays

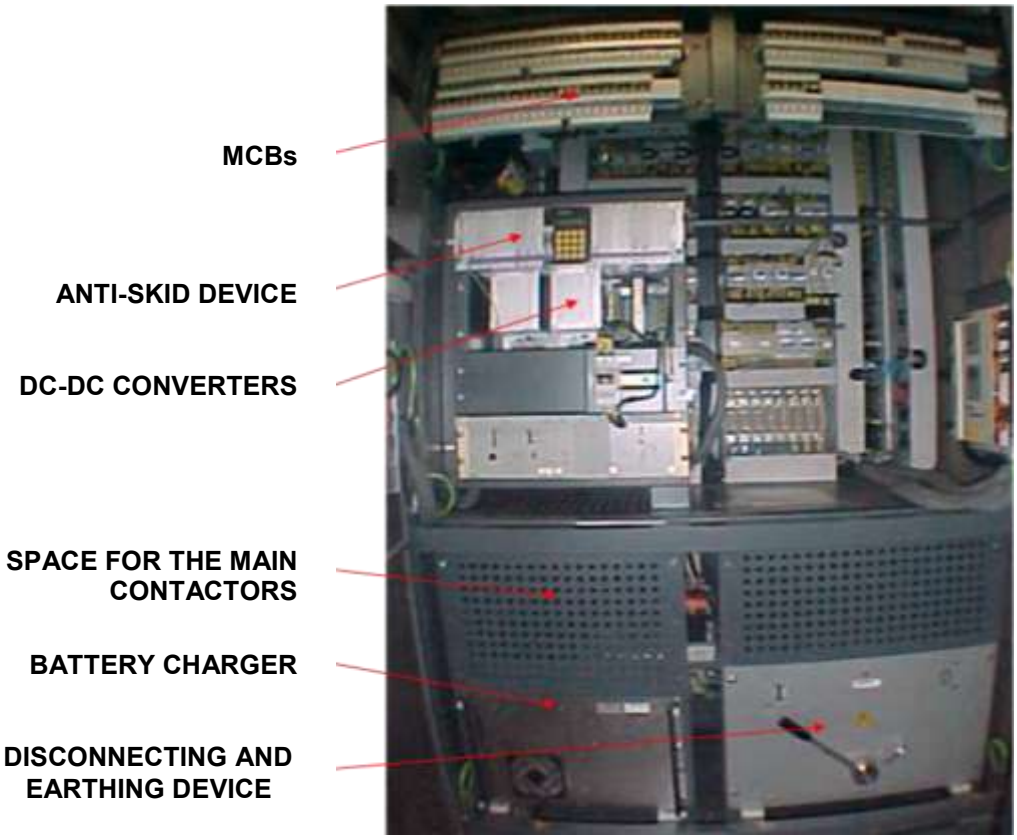


Figure 6.3 Switch-Board Cabinet- S1

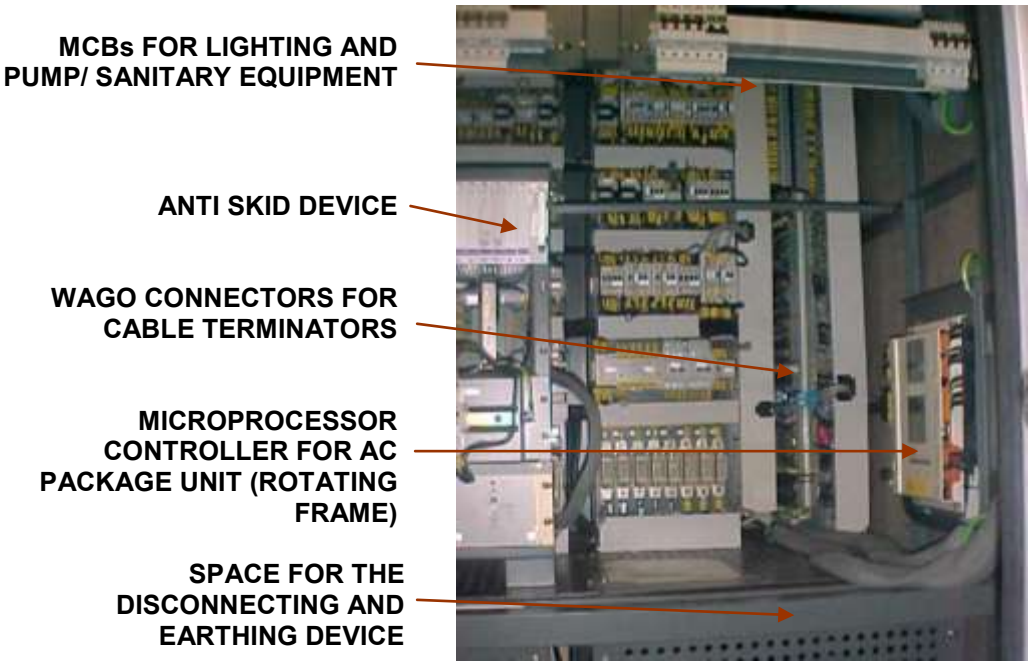


Figure 6.4 Inside View of Switch-Board

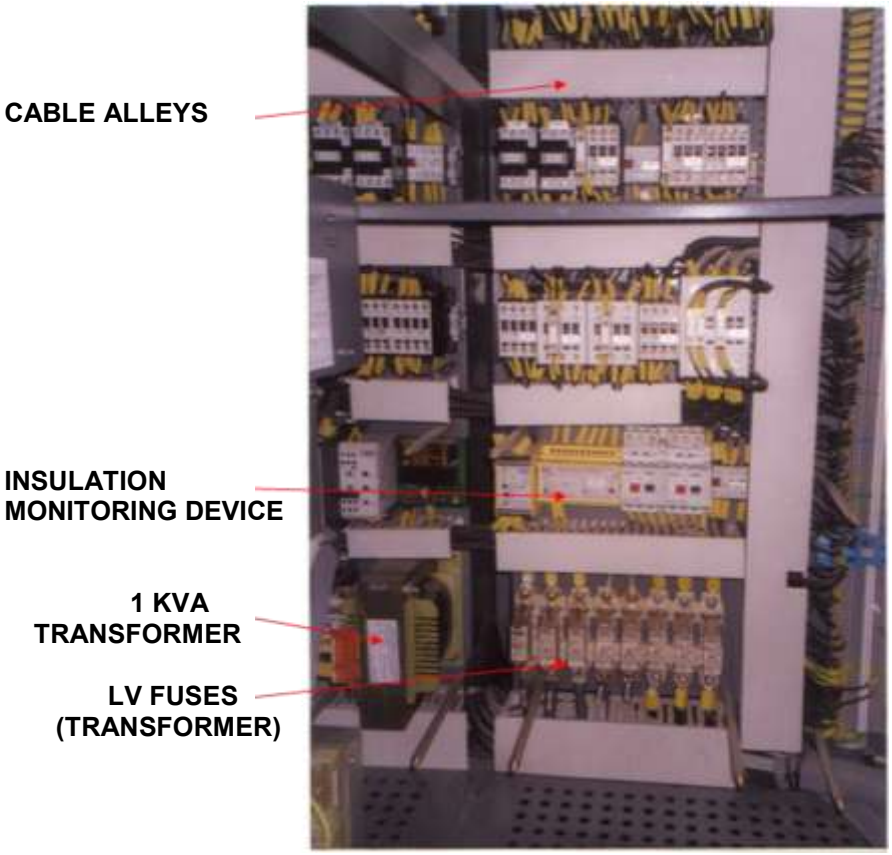


Figure 6.5 Switchboard View with Top Right Door Open

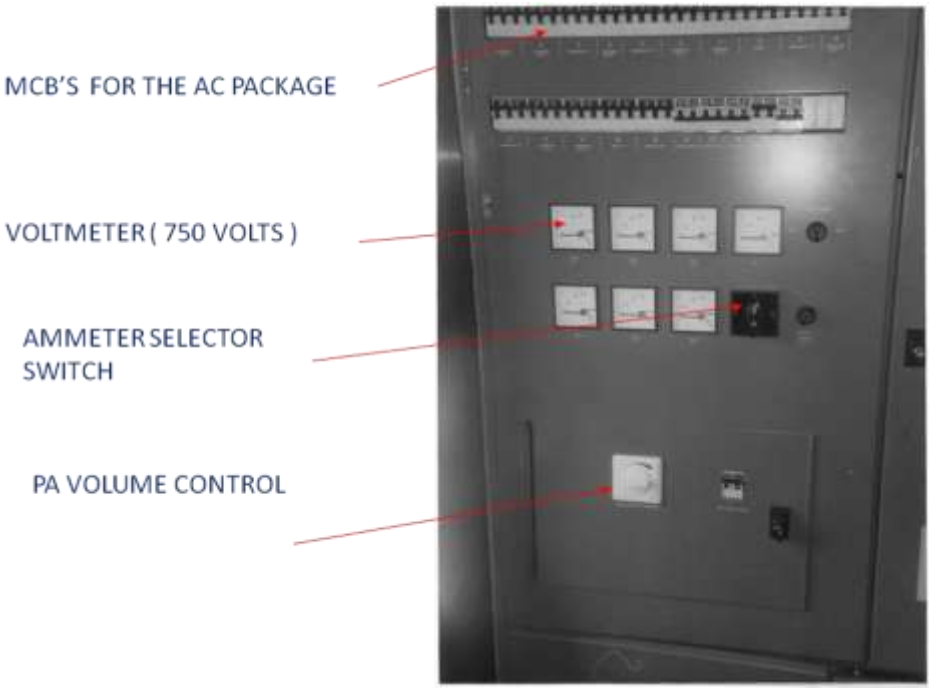


Figure 6.6 Indication and Controls on Left Side Door

Additions / Modifications done

- Provision of individual leaf doors with push type locking arrangement have been provided and the front mechanical cover door has been removed as shown in figure 6.7.
- Provision of stainless steel doors for the bottom panel doors, which were prone to corrosion.
- Left door has been made in two parts for easy removal of battery charger in case of LHB 2-Tier and 3-Tier coaches as shown in figure 6.7.
- In the original design coaches, the feeder contactors are with 110 volts DC control, however in the later coaches these have been changed to 415 volts AC like the conventional AC coaches

Figure 6.7 Modified Doors Arrangement

6.2.2 Disconnecting and Earthing Device

Disconnecting and Earthing Device is an OFF load device rated for 125 amps at 750 volts fed from Generator Car through ZS couplings. This is provided in Switch Board Cabinet. It has two positions **ON** & **EARTH**. It disconnects feed at 750V and earths the coach in case of emergency like contactor jamming or maintenance of coach even during running of coaches.

Figure 6.8 Disconnecting and Earthing Device

6.2.3 Main Features of Air Conditioning System

- Microprocessor controlled Roof Mounted AC package unit
- Humidity control
- Pressure transducers for LP/ HP measurement
- NTC type temperature sensor

6.2.4 Microprocessor Controlled AC Package Unit (RMPU type)

Microprocessor controlled, two AC package units are provided in each coach at the ends. Both package units are controlled by a microcomputer based controller, mounted in switch board cabinet S1 and fed from battery net. These units work in fully automatic mode. Depending on ambient temperature, available modes of heating, ventilating, cooling and dehumidifying are selected and controlled.

6.2.4.1 Technical Data (Output data per unit)

Cooling capacity	7.0TR
Heating capacity	6.0 kW
Compressor motors	4.9 kW
Nominal power	16.5 kVA
Supply Voltage	415 V, 3 Ø, AC, 50 Hz
Fan motor axial (for condenser)	1HP, 415V, 3 Ø, AC, 50 Hz
Fan motor radial (for evaporator)	1.5HP, 415V, 3 Ø, AC, 50 Hz
Air volume	
Fresh air supply (m^3/hr)	820
Max. power input, cooling (kW)	13.25
Max. power input, heating (kW)	6.0
Max. power input, dehumidifying (kW)	11.0 Approximate
Refrigerant	R-22
Weight (kg)	630 Approximate
Dimensions (mm)	2200 x 2000 x 500

Quantity of refrigerant

RMPU Make	Approx. Qty. per unit
Fedders Lloyd/ LELL	4.2 kg per unit
Amit	3.2 kg per unit
SIDWAL/ INTEC	2.85 kg per unit

CONDENSER FANS AIR INTAKE FOR CONDENSER FANS

Figure 6.9 Roof Mounted AC Package Unit

Each air conditioning package unit has two separate cooling circuits consisting of following components:

- Refrigeration compressors - Two (no.s)
- Condensers with Copper pipes and Aluminum fins - Two (no.s)
- condenser fan - Two (no.s)
- Evaporators with Copper pipes and Aluminum fins - Two (no.s)
- Heating assembly - One (no.s)
- Twin-sucking radial fans for supply air (driven by single motor) - One (no.s)
- Maintenance covers - Six (no.s)
- Air inlets for circulating air - Two (no.s)
- Air inlets for fresh air - Two(no.s)
- Mixed air filters & Fresh air filter - for two (no.s) of each
- Air outlet for supply air - One (no)
- Control and safety devices - HP-2,LP-2,OHP-1 ESTI-1,control Pressure-2.

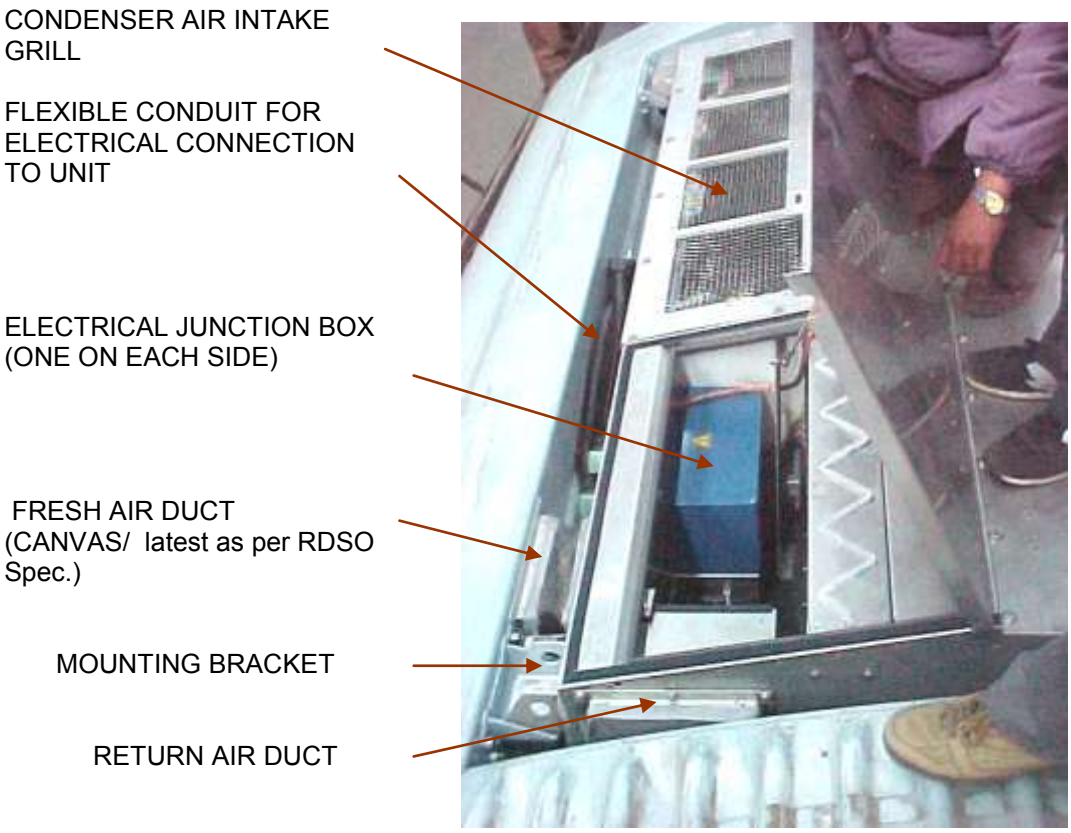


Figure 6.10 View of RMPU with Side Cover Open

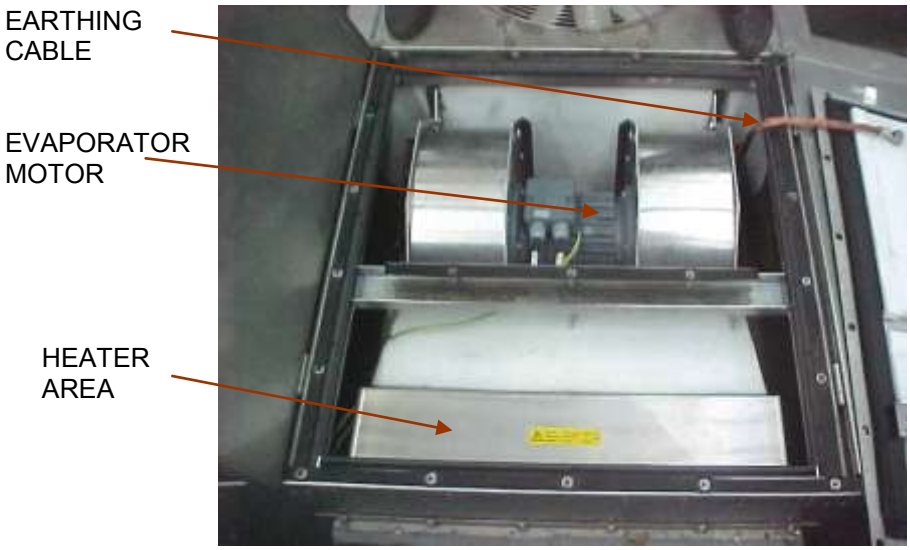


Figure 6.11 Evaporator Motor Unit in RMPU

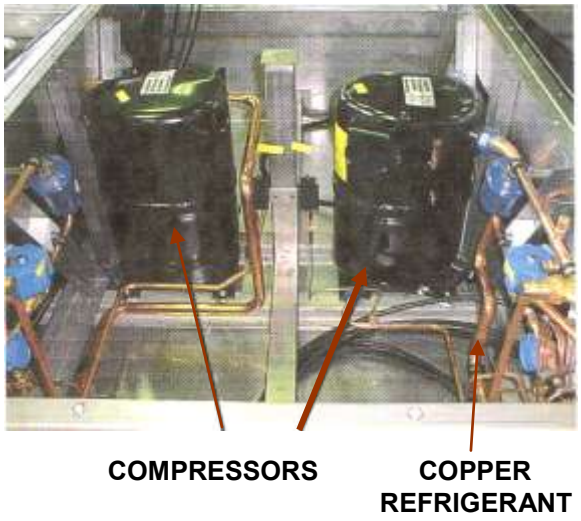


Figure 6.12 Compressors Units in RMPU

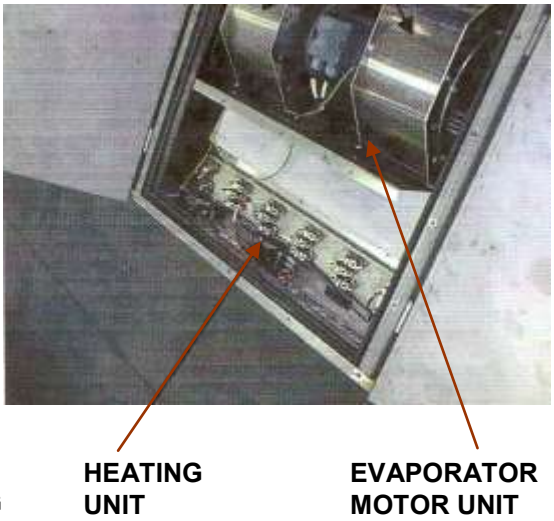


Figure 6.13 RMPU Heating Unit

Figure 6.14 Pressure Transducers in RMPU

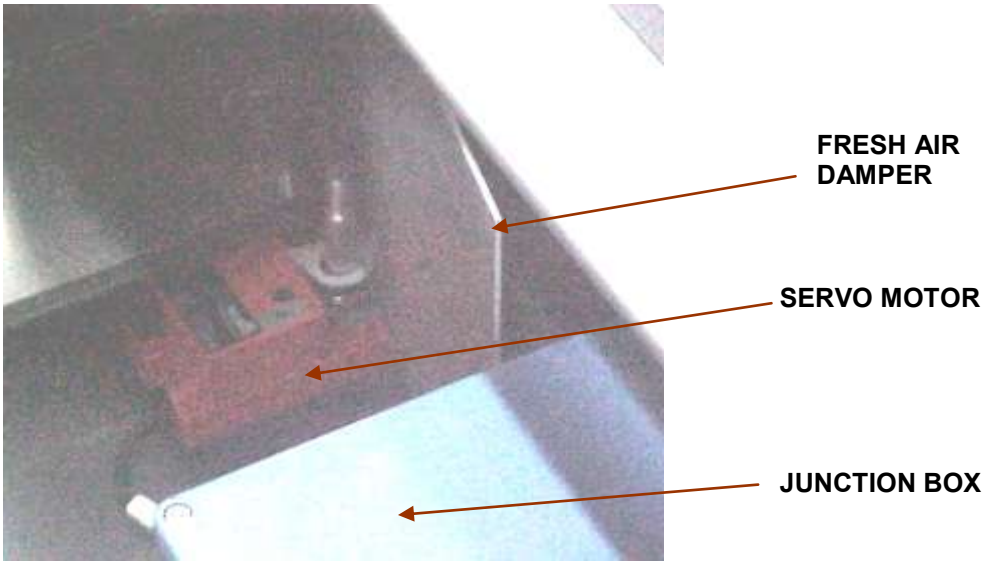
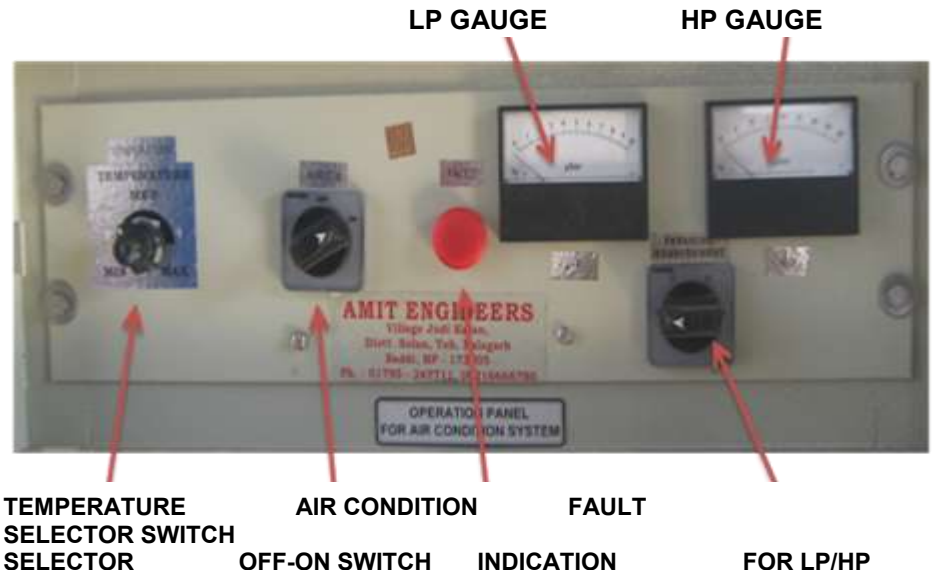


Figure 6.15 Servomotor Controlled Fresh Air Dampers in RMPU

Control Panel



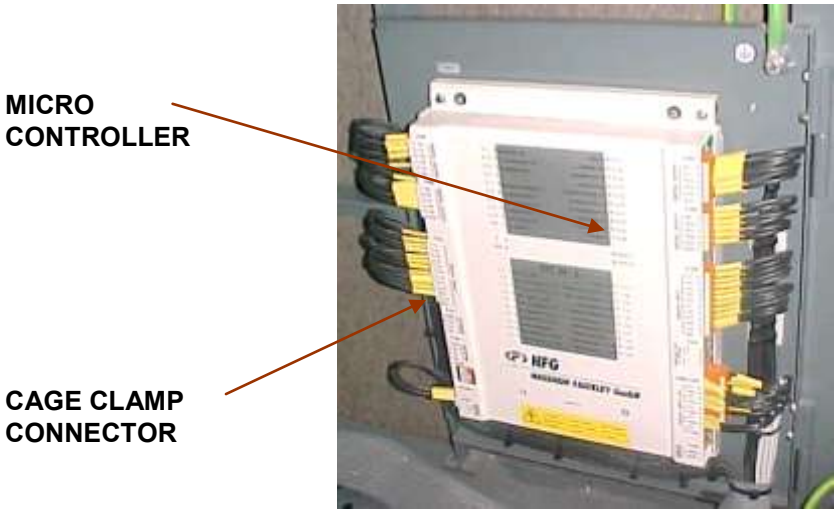


Figure 6.16 Microprocessor Based Controller for RMPU

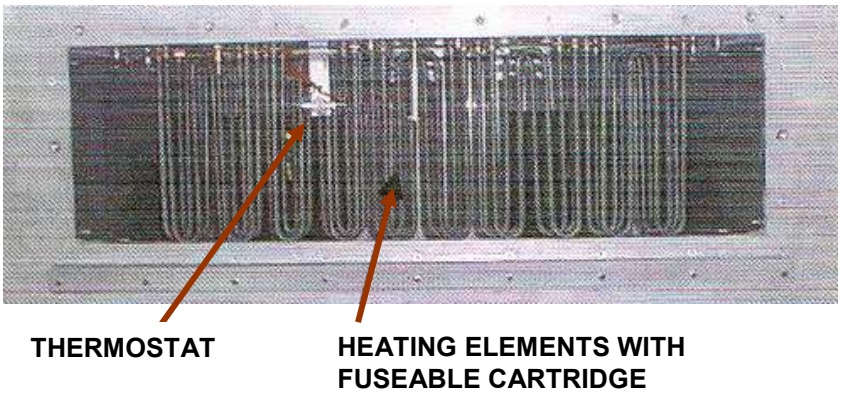


Figure 6.17 Heating Unit Elements in RMPU

6.2.4.2 General Data

a) Compressor
   i. Hermetically sealed scroll compressor
   ii. Each with min 3.5 TR capacity at 60 Deg C condensing and 5 Deg C evaporating temperature.
   iii. Total rating of AC package unit not less than 7 Tr.

b) Heat Exchangers
   i. Air cooled
   ii. Copper tubes with aluminum fins

c) Filters
   i. Each unit has 2 fresh air and 2 mixed air filters
   ii. Material is progressively structured, non – woven break resistant, thermally bonded fire retardant synthetic material.

d) Humidity Control
   i. Restricts the humidity level to 60 %
   ii. Monitored by Hygrostat
   iii. Desired temperature is achieved by switching on heaters as per logic, such that the combined power consumption does not exceed the permissible power under cooling capacity.

e) Sensors
   i. NTC type sensors
   ii. Temperature settings are achieved by rotary switch provided on the Switch Board Cabinet.

Position of switch	Temperature	
	Cooling	Heating
1	20.0 Deg C	17.0 Deg C
2	20.5 Deg C	17.5 Deg C
3	21.2 Deg C	18.2 Deg C
4	21.9 Deg C	18.9 Deg C
5	22.6 Deg C	19.6 Deg C
6	24.3 Deg C	20.3 Deg C
7	25.0 Deg C	21.0 Deg C

f) Refrigerating Piping
   i. As per drawing enclosed.

g) Protections
   i. LP, HP cut outs have been provided in the refrigerant circuit
   ii. Overheat protector has been provided in the heater circuit
   iii. ESTI protection has been provided in the heater circuit to operate at 130°C in case of failure of overheat protector for ultimate disconnection of power supply to heater.
   iv. Individual electrical protection has been provided by MCB‟s
   v. In-built overheat protection has also been provided in the motors windings, which are interlocked with microprocessor.

6.2.5 Ratings of Important Equipment

SN	Equipment	Rating	Qty/ Coach
1	Step down Transformer	3 Ø, 750 V/ 415V AC, 60kVA	1
2	Battery	70 Ah, 12 V Monoblock, Lead Tin/ VRLA	9 Mono blocks
3	Sealed Compressor	3 Ø, 415 V AC	4
4	Condenser Motor	1 HP, 3 Ø, 415 V AC	4
5	Blower Motor	1.5 HP, 3 Ø, 415 V AC	2
6	Condenser Coil	Fin on tube type	4
7	Cooling Coil	Fin on tube type	4
8	Heater Unit	3 Ø, 415 V AC, 6 kW	2
9	Monoblock Pump	3 Ø, 415 V AC, 0.5 HP	2
10	Emergency Battery Charger	Input : 230V±5%, 1 Ø Output : 110 V DC	1
11	Regulated Battery Charger	Input: 415V, 3 Ø, AC Output: 110 V DC	1

6.3 MAIN TRAIN LIGHTING EQUIPMENT

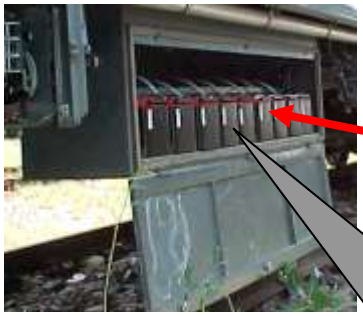
- 110V (9 modules of 12 volt, 70Ah) VRLA battery
- Battery fuse box
- Battery charger
- Internal light fittings

6.3.1 110V (9 modules of 12 volt, 70 Ah) VRLA Battery (As per RDSO Spec. no. RDSO/ SPEC./AC/0009-2008 Rev.1 with amendment No. 1 dtd. June, 2009)

Coaches are provided with 9 modules of 12 volt 70Ah, VRLA battery in series in one battery box. the auxiliary power required for charging is supplied by a battery charger at constant voltage based as required by the battery. current limit for battery charging is 20 Amp. on board charging at constant voltage with the voltage setting at 122.0 ± 1.0 volt.

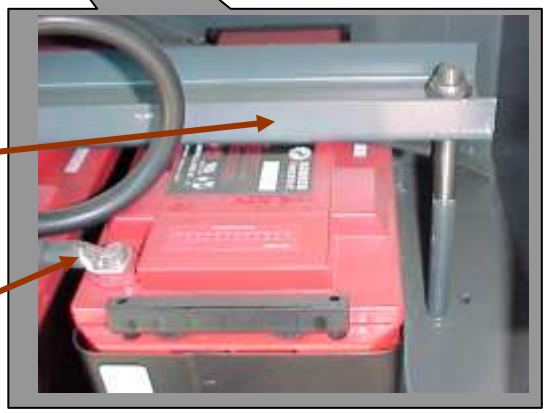
Module Salient Features

- Capacity : 12 V 70 Ah (at 27° C) battery module
- Container : PP-CP (Polypropylene Co-Polymers) V2 grade/ ABS FR V2 grade
- Rate of Discharge : 10 hr
- Overall length : 352 mm
- Maximum height : 178 mm
- Dimensions width : 170 mm
- Maximum weight per module : 26.5 Kg



9 MODULES OF 12 VOLTS EACH
TOTAL WEIGHT 235 Kg

Figure 6.18 Battery Box



Battery Module Details

6.3.2 Battery Fuse Box

Battery fuse box is provided in under frame supported on brackets by fixing bolts. This box is properly earthed by earth cable. It is totally covered and locked by hinged bolts.

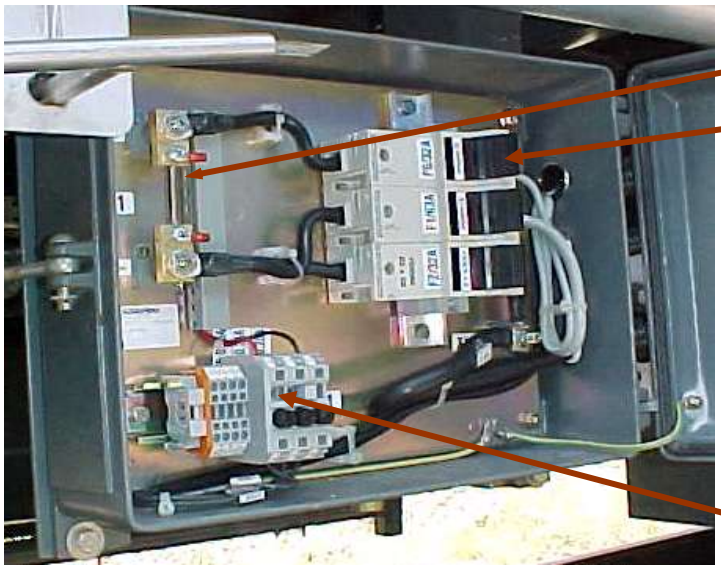


Figure 6.19 Battery Fuse Box (-ve)

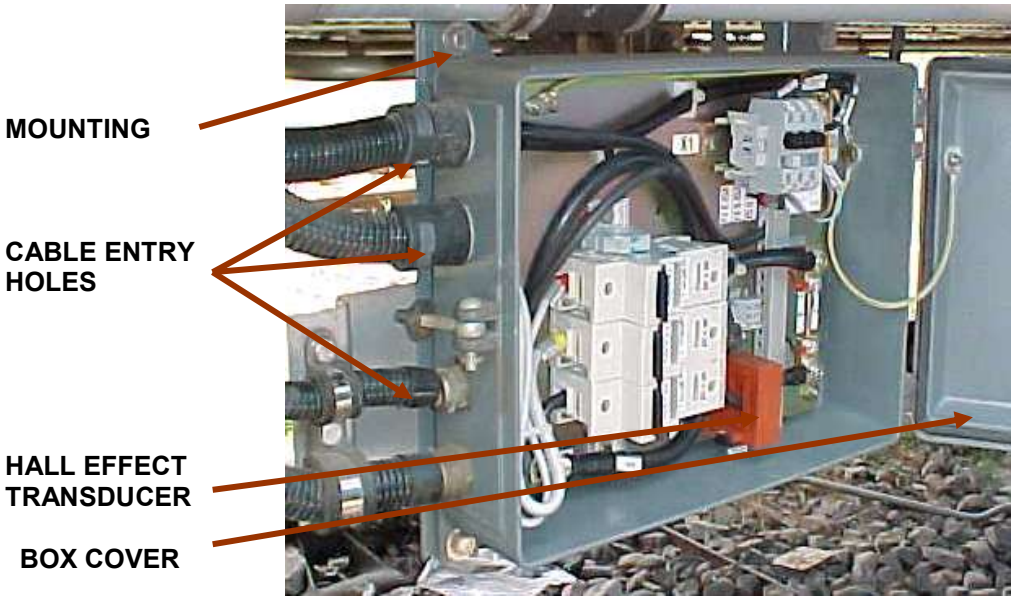


Figure 6.20 Battery Fuse Box (+ve)

Note :- Hall Effect Transducer has been eliminated and has been integrated in the regulated battery charger itself

6.3.3 IGBT Based Battery Charger

A **19"** Switch Cabinet rack, force cooled mounted inside Switch Board Cabinet, with current and temperature sensors. It converts transformer"s secondary voltage **3Ø, 415V, AC** into **110V, DC** for charging battery and feeding direct voltage loads. It has a power capacity of **6.5 kW**. The unit is mounted inside the switchboard cabinet with cool air being sucked in from the front. The connection to the battery charger is by means of circular connectors and a Wago terminal strip is provided behind / side of the charger for connections in the switchboard cabinet itself. It has following features:

- Phase angle control for CVCI charging
- Low voltage and current ripples as low as 2% and THD less than 3%.
- Charging dependent on electrolyte temperature which is monitored by temperature sensor provided inside battery box.
- Soft start and quick shutdown

Figure 6.21 Battery Charger

Modifications / changes

i. The Hall Effect transducer provided in Battery fuse box (to control the charging current of the battery) in the earlier OEM design coaches has been shifted to the battery charger itself.

ii. The wiring for the same has also been removed.

iii. The revised connection diagram is as indicated at annexure.

6.3.4 Light Fittings

Light fittings are provided with injection moulded and extruded diffuser for defused lighting with uniformity of illumination and lumen as per UIC. These fittings are screw less and press fit type. Vestibule, toilet, pantry and emergency lighting works at 110V AC /DC with inverter and poly carbonate diffusers. Reading lights are halogen type. Complete lighting is with high frequency ballast (58 kHz) for flicker free comfort lighting.

6.3.4.1 Ratings of different lightings

Fluorescent tubes (watt) : 18
Halogen lamp (watt) : 10 (reading lights)

6.3.4.2 Compartment light fitting

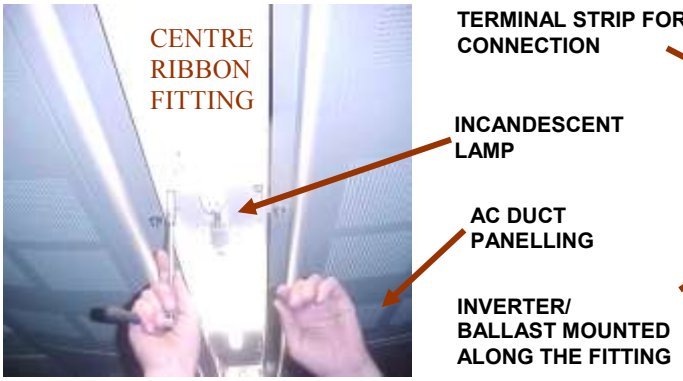


Figure 6.22 Compartment Light Inside View

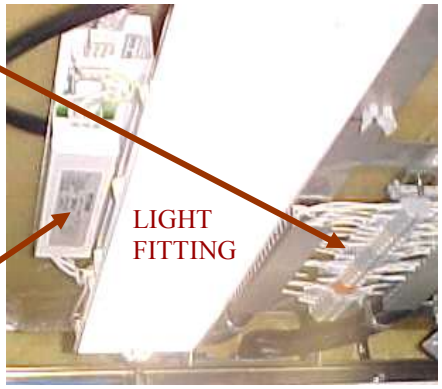


Figure 6.23 Fluorescent Light Fitting Inverter

6.3.4.3 Vestibule light fitting

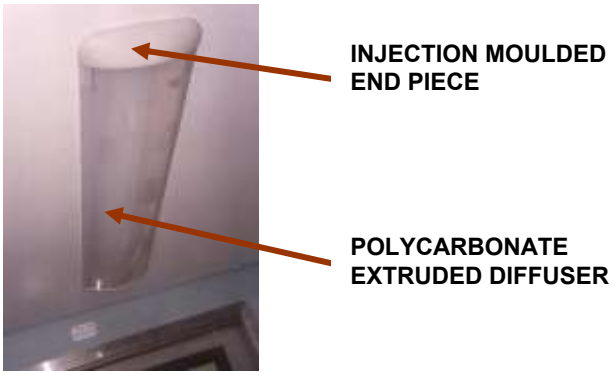


Figure 6.24 Vestibule Light Fitting

6.3.4.4 Door way light fitting

Figure 6.25 Doorway Light Fitting

6.3.4.5 Reading Light

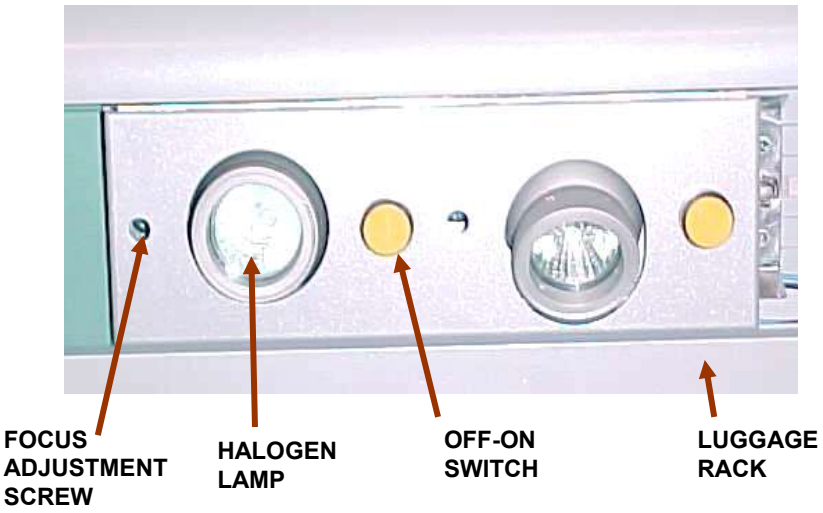


Figure 6.26 Reading Light Fitting

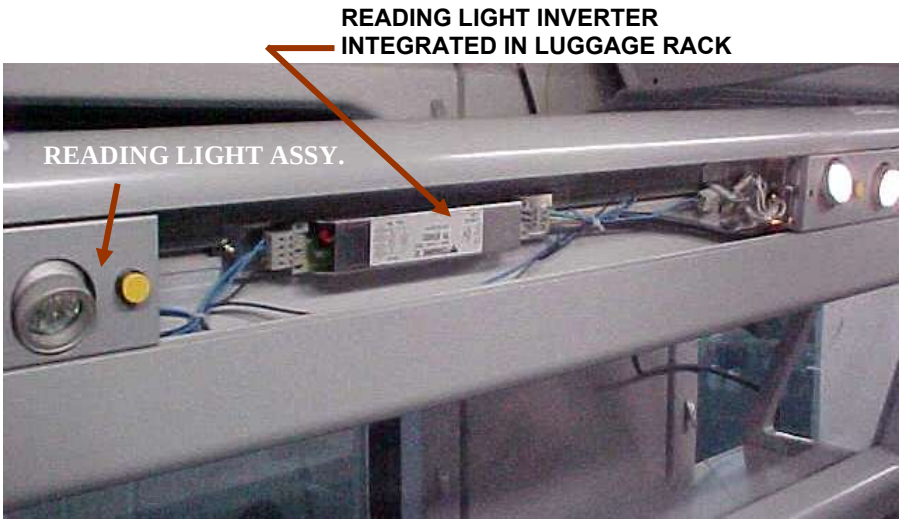


Figure 6.27 Reading Light Inverter / Ballast

6.4 DESCRIPTION OF VARIOUS MODULES

NAME	DESCRIPTION	SUPPLY VOLTAGE
A-1	AC Compact Controller	110 VDC
A-2	Disconnecting & Earthing Device	750 VAC, 110 VDC
A-3	Regulated Battery Charger (RBC)	415 VAC/110 VDC
A-5	Pump Controller	110 VDC, 24 VDC
A-6	Insulation Control Relay AC 110V	220 VAC, 110 VAC
A-7	Insulation Control Relay AC 240V/415V	220 VAC
A-8	DC/ DC Converter (110V/24V) for Return/ Fresh Air Flap Servo Motors, Bar Gauges & Transducers	110 VDC/24 VDC

6.5 PROTECTION DEVICES

NAME	DESCRIPTION	SUPPLY VOLTAGE
F-01	MCB (Triple Pole) 10A for Ventilation Fan Motor Unit 1 (Blower Motor-1)	415 VAC
F-02	MCB (Triple Pole) 10A for Ventilation Fan Motor Unit 2 (Blower Motor-2)	415 VAC
F-03	MCB (Triple Pole) 20A for Compressor Motor 1.1	415 VAC
F-04	MCB (Double Pole) 10A for Crankcase Heaters (for CP 1.1 & CP 1.2)	220 VAC
F-05	MCB (Triple Pole) 20A for Compressor Motor 1.2	415 VAC
F-06	MCB (Triple Pole) 10A for Condenser Fan Motor 1.1	415 VAC
F-07	MCB (Triple Pole) 10A for Condenser Fan Motor 1.2	415 VAC
F-08	MCB (Triple Pole) 6A for Heater Unit-1 (NPPS)	415 VAC
F-09	MCB (Triple Pole) 20A for Compressor Motor 2.1	415 VAC
F-10	MCB (Double Pole) 10A for Crankcase Heaters (for CP 2.1 & CP 2.2)	220 VAC
F-11	MCB (Triple Pole) 20A for Compressor Motor 2.2	415 VAC
F-12	MCB (Triple Pole) 10A for Condenser Fan Motor 2.1	415 VAC
F-13	MCB (Triple Pole) 10A for Condenser Fan Motor 2.2	415 VAC
F-14	MCB (Triple Pole) 16A for Heater Unit-2 (PPS)	415 VAC
F-15	MCB (Triple Pole) 16A for Exhaust Fans	415 VAC
F-16	MCB (Double Pole) 16A for Water Boiler	220 VAC
F-17	MCB (Double Pole) 10A for Soup Boiler	220 VAC
F-18	MCB (Double Pole) 16A for Hot Case	220 VAC
F-19	MCB (Double Pole) 6A for Bottle Cooler	220 VAC
F-20	MCB (Double Pole) 6A for Refrigerator (Deep Freezer)	220 VAC
A-21	MPCB (Motor Protection Circuit Breaker) (1 to 1.6A) for Water Pump-1	415 VAC
A-22	MPCB (Motor Protection Circuit Breaker) (1 to 1.6A) for Water Pump-2 (Overload Relay for Water Pump-2)	415 VAC
F-24	MCB (Double Pole) 10A for Light Control	110 VDC

NAME	DESCRIPTION	SUPPLY VOLTAGE
F-25	MCB (Double Pole) 10A for Emergency Lights	110 VDC
F-26	MCB (Double Pole) 10A for Emergency Lights	110 VDC
F-27	MCB (Double Pole) 16A for Reading Lights	110 VDC
F-28	MCB (Double Pole) 16A for Reading Lights	110 VDC
F-29	MCB (Double Pole) 16A for DC/DC Converter	110 VDC
F-30	MCB (Double Pole) 6A for Minimal Voltage Relay	110 VDC
F-31	MCB (Double Pole) 6A for Telephone (First Class only)	110 VDC
F-32	MCB (Double Pole) 6A for Diagnosis (Indications & ACP lights)	110 VDC
F-33	MCB (Double Pole) 10A for Power Supply	110 VDC
F-34	MCB (Double Pole) 10A for Night Lights	110 VDC
F-35	MCB (Double Pole) 6A for AC Compact Controller	110 VDC
F-36	MCB (Double Pole) 6A for Pump Control	24 VDC, 110 VDC
F-37	MCB (Double Pole) 10A for Sanitary Control	24 VDC
F-38	MCB (Double Pole) 10A for Loud Speaker	24 VDC
F-39	MCB (Double Pole) 10A for Coach Light	110 VAC
F-40	MCB (Double Pole) 10A for Coach Light	110 VAC
F-41	MCB (Double Pole) 6A for Electric Razor Socket	110 VAC
F-42	HRC Fuse (25A) for 110V (+ve) DC Supply to Panel	110 VAC
F-43	HRC Fuse (25A) for 110V (-ve) DC Supply to Panel	110 VAC
F-44	HRC Fuse (100A) in R-phase of Output of 60 KVA Transformer	415 VAC
F-45	HRC Fuse (100A) in Y-phase of Output of 60 KVA Transformer	415 VAC
F-46	HRC Fuse (100A) in B-phase of Output of 60 KVA Transformer	415 VAC
F-47	HRC Fuse (80A) in Local Main Supply (R-phase)	415 VAC
F-48	HRC Fuse (80A) in Local Main Supply (Y-phase)	415 VAC
F-49	HRC Fuse (80A) in Local Main Supply (B-phase)	415 VAC
F-50	HRC Fuse HT (63A) in R-phase for Network-1(Feeder-1)	750 VAC
F-51	HRC Fuse HT (63A) in Y-phase for Network-1(Feeder-1)	750 VAC
F-52	HRC Fuse HT (63A) in B-phase for Network-1(Feeder-1)	750 VAC
F-53	HRC Fuse HT (63A) in R-phase for Network-2(Feeder-2)	750 VAC
F-54	HRC Fuse HT (63A) in Y-phase for Network-2(Feeder-2)	750 VAC
F-55	HRC Fuse HT (63A) in B-phase for Network-2(Feeder-2)	750 VAC
F-56	Glass Fuse (4A) UIC Remote Control (+ve)	24 VDC
F-57	Glass Fuse (2A) UIC Remote Control (-ve)	24 VDC

NAME	DESCRIPTION	SUPPLY VOLTAGE
F-58	Glass Fuse (2A) in Phase for AC 110V Insulation Control Relay (A-6)	110 VAC
F-59	Glass Fuse (2A) in Neutral for AC 110V Insulation Control Relay (A-6)	110 VAC
F-60	Glass Fuse (4A) in Phase for AC 110V Insulation Control Relay (A-6) & AC 240V/415V Insulation Control Relay (A-7)	220 VAC
F-61	Glass Fuse (4A) in Neutral for AC 110V Insulation Control Relay (A-6) & AC 240V/415V Insulation Control Relay (A-7)	220 VAC
F-62	Glass Fuse (2A) in Neutral for AC 110V Insulation Control Relay (A-6) & AC 240V/415V Insulation Control Relay (A-7)	220 VAC
F-63	Glass Fuse (6.3A) in +ve 110V DC for Anti Skid Device	110 VDC
F-64	Glass Fuse (6.3A) in +ve 110V DC for Brake	110 VDC
F-65	Glass Fuse (6.3A) in -ve 110V DC for Anti Skid Device	110 VDC
F-66	Glass Fuse (6.3A) in -ve 110V DC for Brake	110 VDC
F-67	Glass Fuse (1A) in Control Supply of K-41	220 VAC
F-68	Glass Fuse (1A) in Control Supply of K-42	220 VAC
F-69	Glass Fuse (1A) in R-phase of K-45 (MMR for LMS)	415 VAC
F-70	Glass Fuse (1A) in Y-phase of K-45 (MMR for LMS)	415 VAC
F-71	Glass Fuse (1A) in B-phase of K-45 (MMR for LMS)	415 VAC
F-72	Glass Fuse (1A) in Control Supply of K-44	220 VAC
F-73	Glass Fuse (1A) in Control Supply of K-23	220 VAC
F-74	Glass Fuse (10A) in Input Phase of Lighting X‟mer	220 VAC
F-75	Glass Fuse (10A) in Input Neutral of Lighting X‟mer	220 VAC
F-76	HRC Fuse (100A) in R-phase of Output of 60 KVA Transformer No. 2 (in Pantry car & German Power car)	415 VAC
F-77	HRC Fuse (100A) in Y-phase of Output of 60 KVA Transformer No. 2 (in Pantry car & German Power car)	415 VAC
F-78	HRC Fuse (100A) in B-phase of Output of 60 KVA Transformer No. 2 (in Pantry car & German Power car)	415 VAC
F-79	HRC Fuse (63A) in R-phase for Radiator Motor, Roof Extractor-1 & 2	415 VAC
F-80	HRC Fuse (63A) in Y-phase for Radiator Motor, Roof Extractor-1 & 2	415 VAC
F-81	HRC Fuse (63A) in B-phase for Radiator Motor, Roof Extractor-1 & 2	415 VAC
F-82	HRC Fuse (63A) in R-phase for Radiator Motor, Roof Extractor-3 & 4	415 VAC
F-83	HRC Fuse (63A) in Y-phase for Radiator Motor, Roof Extractor-3 & 4	415 VAC
F-84	HRC Fuse (63A) in B-phase for Radiator Motor, Roof Extractor-3 & 4	415 VAC

NAME	DESCRIPTION	SUPPLY VOLTAGE
F-85	Motor Protection Circuit Breaker (MPCB) (0.1 to 2.5A) for Exhaust Fan-I	415 VAC
F-86	Motor Protection Circuit Breaker (MPCB) (0.1 to 2.5A) for Exhaust Fan-II	415 VAC
F-87	Motor Protection Circuit Breaker (MPCB) (0.25 to 4.0A) for Exhaust Fan-III	415 VAC
F-90	HRC Fuse (1A) in R-phase of 750V Volt Meter Network-1 (Feeder-1)	750 VAC
F-91	HRC Fuse (1A) in Y-phase of 750V Volt Meter Network-1 (Feeder-1)	750 VAC
F-93	HRC Fuse (1A) in B-phase of 750V Volt Meter Network-1 (Feeder-1)	750 VAC
F-94	HRC Fuse (1A) in R-phase of 750V Volt Meter Network-2 (Feeder-2)	750 VAC
F-95	HRC Fuse (1A) in Y-phase of 750V Volt Meter Network-2 (Feeder-2)	750 VAC
F-96	HRC Fuse (1A) in B-phase of 750V Volt Meter Network-2 (Feeder-2)	750 VAC
F-97	HRC Fuse (1A) in Control Supply of K-01 Net-1 Contactor (in Rev.-D only)	750 VAC
F-98	HRC Fuse (1A) in Control Supply of K-01 Net-2 Contactor (in Rev.-D only)	750 VAC
F-100	Glass Fuse (2A) in Phase of Insulation Control Relay AC 415/240V for Transformer-1 (in Power Cars only)	220 VAC
F-101	Glass Fuse (2A) in Phase of Insulation Control Relay AC 415/240V for Transformer-1 (in Power Cars only)	220 VAC
F-102	Glass Fuse (2A) in Phase of Insulation Control Relay AC 415/240V for Transformer-2 (in Power Cars only)	220 VAC
F-103	Glass Fuse (2A) in Phase of Insulation Control Relay AC 415/240V for Transformer-2 (in Power Cars only)	220 VAC

6.6 INDICATIONS

NAME	DESCRIPTION	SUPPLY VOLTAGE
H-1	Indication Operation Supply Net-1	110 VDC
H-2	Indication Operation Supply Net-2	110 VDC
H-3	Indication Operation Battery Charger Float	110 VDC
H-4	Indication Operation Local Main Supply-1	110 VDC
H-5	Indication Operation Local Main Supply-2	110 VDC
H-6	Indication Operation Battery Charger Boost	110 VDC
H-7	Indication Anti Skid Device Defect	110 VDC
H-8	Indication Insulation Failure 110V	110 VDC
H-9	Indication Insulation Failure 415V	110 VDC
H-10	Indication Operation 415V OK	110 VDC
H-11	Indication Operation MMR Net-1OK	110 VDC
H-12	Indication Operation MMR Net-2OK	110 VDC

6.7 CONTACTORS & RELAYS

NAME	DESCRIPTION	SUPPLY VOLTAGE
K-01	Main Feeder Contactor Network-1 (Feeder-1)	110 VDC, 750 VAC
K-02	Main Feeder Contactor Network-2 (Feeder-2)	110 VDC, 750 VAC
K-03	Measuring & Monitoring Relay (MMR) for Network-1(Feeder-1) 750 VAC	24 VDC, 110 VDC,
K-04	Measuring & Monitoring Relay (MMR) for Network-2(Feeder-2) 750 VAC	24 VDC, 110 VDC,
K-05	Timer for Anti Skid Device	110 VDC
K-06	Contactor for Electro Pneumatic Brake Application	24 VDC, 110 VDC
K-07	Contactor for Electro Pneumatic Brake Release	24 VDC, 110 VDC
K-08	Contactor for Level 1 of Minimal Voltage Relay (MVR) (96V+120 Minutes for Emergency Light OFF)	110 VDC
K-09	Contactor for Level 2 of Minimal Voltage Relay(MVR) (104V+30 Minutes for DC/DC Converters OFF)	110 VDC
K-10	Contactor for Level 3 of Minimal Voltage Relay (MVR) (106V for Reading Light OFF)	110 VDC, 220 VAC
K-11	Contactor for Main Light Passenger Room	110 VDC, 110 VAC
K-12	Contactor for Reading Light	110 VDC
K-13	Contactor for Night Light	110 VDC
K-14	Contactor for Main Light Entrance Area & Sanitary Rooms	110 VDC, 110 VAC
K-15	Contactor for Emergency Light	110 VDC
K-16	Contactor for Emergency Light	110 VDC
K-17	Timer for Light ON/OFF (15-300 Min)	110 VDC
K-18	Timer for External Power Supply/ Local Main Supply (L.M.S.) (for blinking of outdoor lamps)	110 VDC
K-19	Relay for UIC-Light-Remote Control ON	24 VDC, 110 VDC
K-20	Relay for UIC-Light-Remote Control OFF	24 VDC, 110 VDC
K-21	Contactor for Fresh Air Flap Motor	24 VDC
K-22	Contactor for Return Air Flap Motor	24 VDC
K-23	Contactor for 415V OK	110 VDC, 220 VAC
K-24	Contactor for Water Pump No. 1	24 VDC/110 VDC, 415 VAC
K-25	Contactor for Water Pump No. 2	24 VDC/110 VDC, 415 VAC
K-26	Contactor for Ventilation Fan Motor Unit-1(Blower-1/NPPS)	110 VDC, 415 VAC
K-27	Contactor for Controller OK	110 VDC

NAME	DESCRIPTION	SUPPLY VOLTAGE
K-28	Contactor for Ventilation Fan Motor Unit-2 (Blower-2/PPS)	110 VDC, 415 VAC
K-29	Contactor for Exhaust Fan Motors	110 VDC, 415 VAC
K-31	Contactor for Condenser Fan Motor 1.1	110 VDC, 415 VAC
K-32	Contactor for Condenser Fan Motor 1.2	110 VDC, 415 VAC
K-33	Contactor for Compressor Motor 1.1	110 VDC, 415 VAC
K-34	Contactor for Compressor Motor 1.2	110 VDC, 415 VAC
K-35	Contactor for Heater Unit 1 (NPPS)	110 VDC, 415 VAC
K-36	Contactor for Condenser Fan Motor 2.1	110 VDC, 415 VAC
K-37	Contactor for Condenser Fan Motor 2.2	110 VDC, 415 VAC
K-38	Contactor for Compressor Motor 2.1	110 VDC, 415 VAC
K-39	Contactor for Compressor Motor 2.2	110 VDC, 415 VAC
K-40	Contactor for Heater Unit 2 (PPS)	110 VDC, 415 VAC
K-41	Contactor for Local Main Supply-2 (LMS-2)	220 VAC, 415 VAC
K-42	Contactor for Local Main Supply-1 (LMS-1)	220 VAC, 415 VAC
K-43	Main Contactor for Local Main Supply (LMS)	110 VDC, 415 VAC
K-44	Contactor in the Output of 60 KVA Transformer (After 100A Fuses)	220 VAC, 415 VAC
K-45	Measuring & Monitoring Relay (MMR) for Local Main Supply (LMS)	110 VDC, 415 VAC
K-46	Contactor in the Output of 60 KVA Transformer-2 (in Original German Power cars & Pantry cars)	220 VAC, 415 VAC
K-48	Interlocking Contactor for Changeover of Coach Light Supply from 110V AC to 110V DC & vice verse	110 VAC, 110 VDC
K-30	Contactor for Regulated Battery Charger (Main Battery Charger)	415 VAC

6.8 METERS

NAME	DESCRIPTION	SUPPLY VOLTAGE
P-1	Ampere Meter, AC (0-200 Amp) for Panel Load	mV
P-2	Volt Meter, AC (0-800V) for Network-1 (RY)	750 VAC
P-3	Volt Meter, AC (0-800V) for Network-1 (YB)	750 VAC
P-4	Volt Meter, AC (0-800V) for Network-1 (BR)	750 VAC
P-5	Volt Meter, AC (0-800V) for Network-2 (RY)	750 VAC
P-6	Volt Meter, AC (0-800V) for Network-2 (YB)	750 VAC
P-7	Volt Meter, AC (0-800V) for Network-2 (BR)	750 VAC
P-8	Ampere Meter, DC (+ve 100-0-100 -ve) for Charge-Discharge Battery Net	mV
P-9	Ampere Meter, DC (0-40Amp) for Consumer Current Battery Net	mV
P-10	Volt Meter, DC (0-150V) for Battery Net	110 VDC

6.9 SWITCHES

NAME	DESCRIPTION	SUPPLY VOLTAGE
S-01	Switch, Selector Power Supply ON/OFF (Rev.-D)	110 VAC, 110 VDC/ 415 VAC, 750 VAC
S-02	Switch, Selector Net-1, Net-2 & LMS (Rev.-D)	110 VDC/ 415 VAC, 750 VAC
S-03	Switch, Push Button for Insulation Test Battery Net +ve	110 VDC
S-04	Switch, Push Button for Insulation Test Battery Net –ve	110 VDC
S-05	Switch, Push Button for Test Indication Lamps	110 VDC
S-06	Switch, Push Button for Train Light ON	24 VDC
S-07	Switch, Push Button for Train Light OFF	24 VDC
S-08	Switch, Push Button for Lighting ON	24 VDC
S-09	Switch, Push Button for Night Lighting ON	110 VDC
S-10	Switch, Push Button for Lighting OFF	110 VDC

6.10 CONVERTERS

NAME	DESCRIPTION	SUPPLY VOLTAGE
U-1	Anti Skid Device	110 VDC
U-2.1	DC/DC Converter (110V/24V) for Water Pump Control & Sanitory Control	110 VDC, 24 VDC
U-2.2	DC/DC Converter (110V/24V) for Loud Speaker System MMRs & UIC Remote Control	110 VDC, 24 VDC
U-2.3	Minimal Voltage Relay (MVR)	110 VDC
U-3	Amplifier Loud Speaker system	24 VDC
U-4	Air Conditioning Control Switch Panel	24 VDC, 110 VDC

6.11 THREE PHASE POWER TERMINAL FOR AC PLANT

Terminal no.	Description		Terminal no.	Description
231	Ventilation-1		256	CD fan 1.2
232			257	
233			258	
234	Earth		259	Compressor 2.1
235	Ventilation-2		260	
236			261	
237			262	Earth
238	Earth		263	Compressor 2.2
239	Compressor 1.1		264	
240			265	
241			266	Earth
242	Earth		267	Heater-2
243	Compressor 1.2		268	
244			269	
245			270	Crank Heater-2
246	Earth		271	
247	Heater-1		272	
248			273	CD fan 2.1
249			274	
250	Crank Heater-1		275	
251			276	CD fan 2.2
252			277	
253	CD fan 1.1		278	
254			279	Exhaust fan
255			280	
			281	

6.12 AC TROUBLE SHOOTING

SN	FAULT	CAUSE	REMEDIAL ACTION
1	Compact control MCB F-35 on microprocessor has NO indication	1) 110V DC supply not available 2) Glass fuse on microcontroller has blown 3) Microcontroller faulty/defective	1) Ensure 110V DC supply 2) Replace glass fuse 3) Replace Microcontroller
2	With MCB-F35 ON, AIR-CON switch ON, but NO output of Micro-controller	1) 415V AC supply not available 2) Check NO contact of K23, replace if required 3) NC contact of K27 not working 4) Blower motor T.O.P tripped	1) Ensure 415V AC supply 2) Replace glass fuse F73 or contactor K23, if defective 3) Check and use spare contact of K27 4) Check overheating of motor
3	MCB F-35 ON, AIR-CON switch ON, only BLOWERs are working	1) Controller OK indication not glowing 2) K-27 contactor not working	1) Replace Micro-controller 2) Check DC supply on K-27, if supply available check NC contact.
4	MCB F-35 ON, AIR-CON switch ON, blower motor starts and trips	1) Vent 1 & 2 indication continuously glowing	1) Check NC contact for blower motor contactor K-26, K-28. If contact OK motor tripped due to phase over heating
5	Condenser motor 1.1 and 2.1 not working	1) Condenser motor 1.1 temperature ok not working 2) Condenser motor 2.1 temperature ok not working	1) TOP of condenser motor tripped check and rectify 1) TOP of condenser motor tripped check and rectify
6	a. Condenser motor 1.2 not working even if HP indication is glowing on Micro-controller	1) Control pressure indication not glowing 2) Temperature condenser motor1.2 not glowing	1) Control pressure switch defective replaced it 1) Motor tripped at TOP, check for over heating
	b). Condenser motor 2.2 not working of even if HP indication is glowing on Micro-controller	1) Control pressure indication not glowing 2) Temperature condenser motor2.2 not glowing	1) Control pressure switch defective replace it 1) Motor tripped at TOP, check for over heating

SN	FAULT	CAUSE	REMEDIAL ACTION
7	Compressor not working	1) Temperature selector switch set at high	1) Set temperature setting Low
		2) LP indication not glowing	2) Check suction pressure and compressor current, recharge gas if required. If LP output are ok check LP switch, replace if defective
		3) HP indication glowing	3) Check if second motor not working replace it, clean the condenser unit if found dirty.
		4) Tripped due to internal overload	4) Ambient Temperature is high or solenoid valve not operating check the circuit.
8	Heater not working	1) Temperature selector switch set at Low	1) Change the Temperature to high
		2) Temperature heater on indication not glowing	2) OHP tripped or CKT may be checked
		3) ESTI fused	3) Replace ESTI
9	DC supply tripping as MICR output signal ON	1) Contactor coil or diode suppressor may be short circuited in condenser or compressor contactor	1) Remove both plant output voltage connectors from Micro-controller and identify the defective contactor by reconnecting one by one and replace the defective contactor

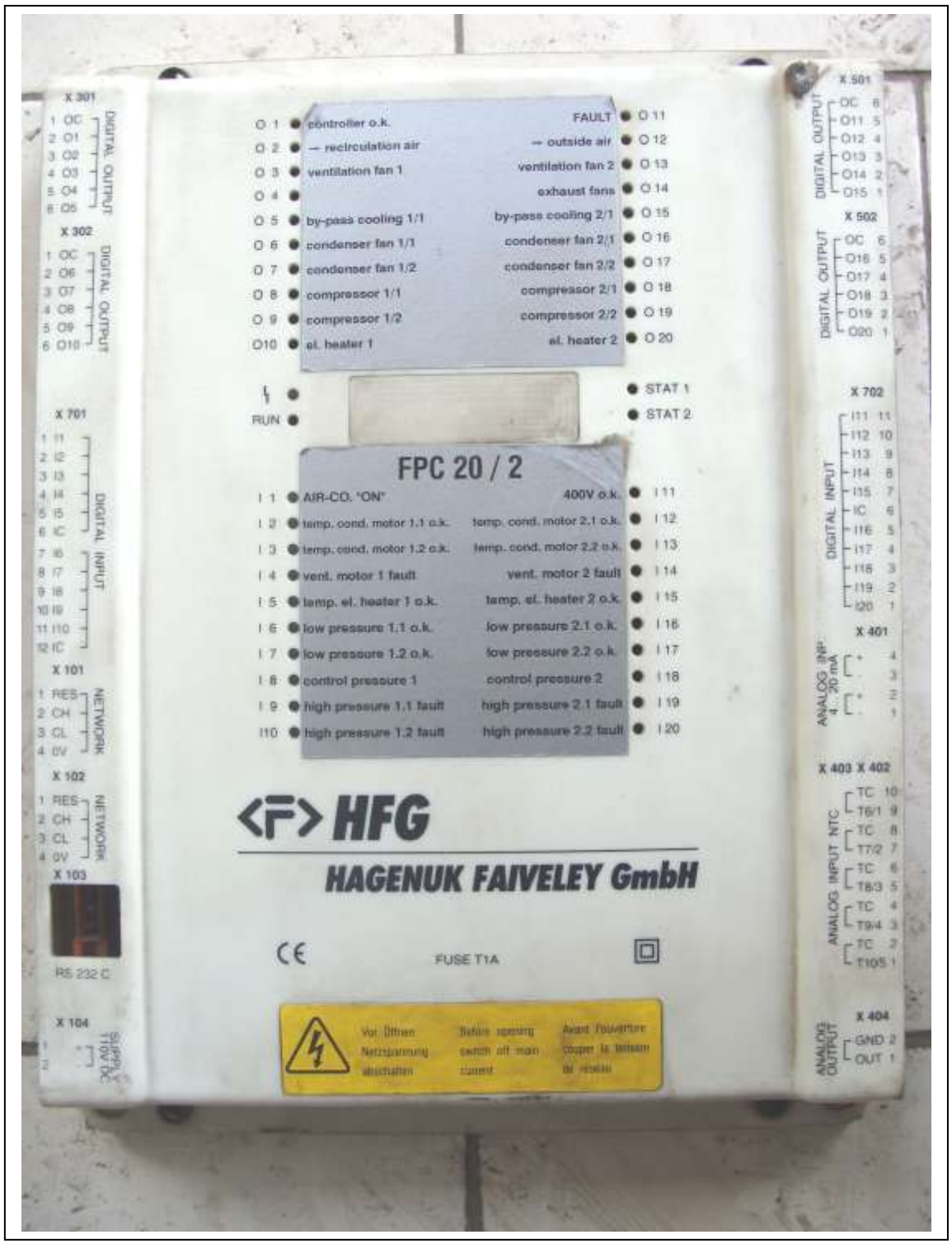
6.13 DESCRIPTION & RATING OF GLASS FUSES PROVIDED IN MAIN PANEL

Fuse No.	Rating (A)	Description (Located in)
75	10	Neutral Input supply to Lighting transformer
74	10	Phase Input supply to Lighting transformer
73	1	Control supply to K-23
72	1	Control supply to K-44
71	1	Blue Phase of MMR of local Main Supply
70	1	Yellow Phase of MMR of local Main Supply
69	1	Red Phase of MMR of local Main Supply
68	1	Control supply to K-42
67	1	Control supply to K-41
66	6.3	-ve 110 VDC supply for Brake
65	6.3	-ve 110 VDC supply for Anti Skid device
64	6.3	+ve 110 VDC supply for Brake
63	6.3	+ve 110 VDC supply for Anti Skid device
62	2	Neutral of AC 110 V Insulation Control relay (A-6) & AC 240/415 V Insulation Control relay (A-7)
61	4	
60	4	Phase of AC 110 V Insulation Control relay (A-6) & AC 240/415 V Insulation Control relay (A-7)
59	2	Neutral of AC 110 V Insulation Control relay (A-6)
58	2	Phase of AC 110 V Insulation Control relay (A-6)
57	2	-ve of 24 V UIC remote control
56	4	+ve of 24 V UIC remote control

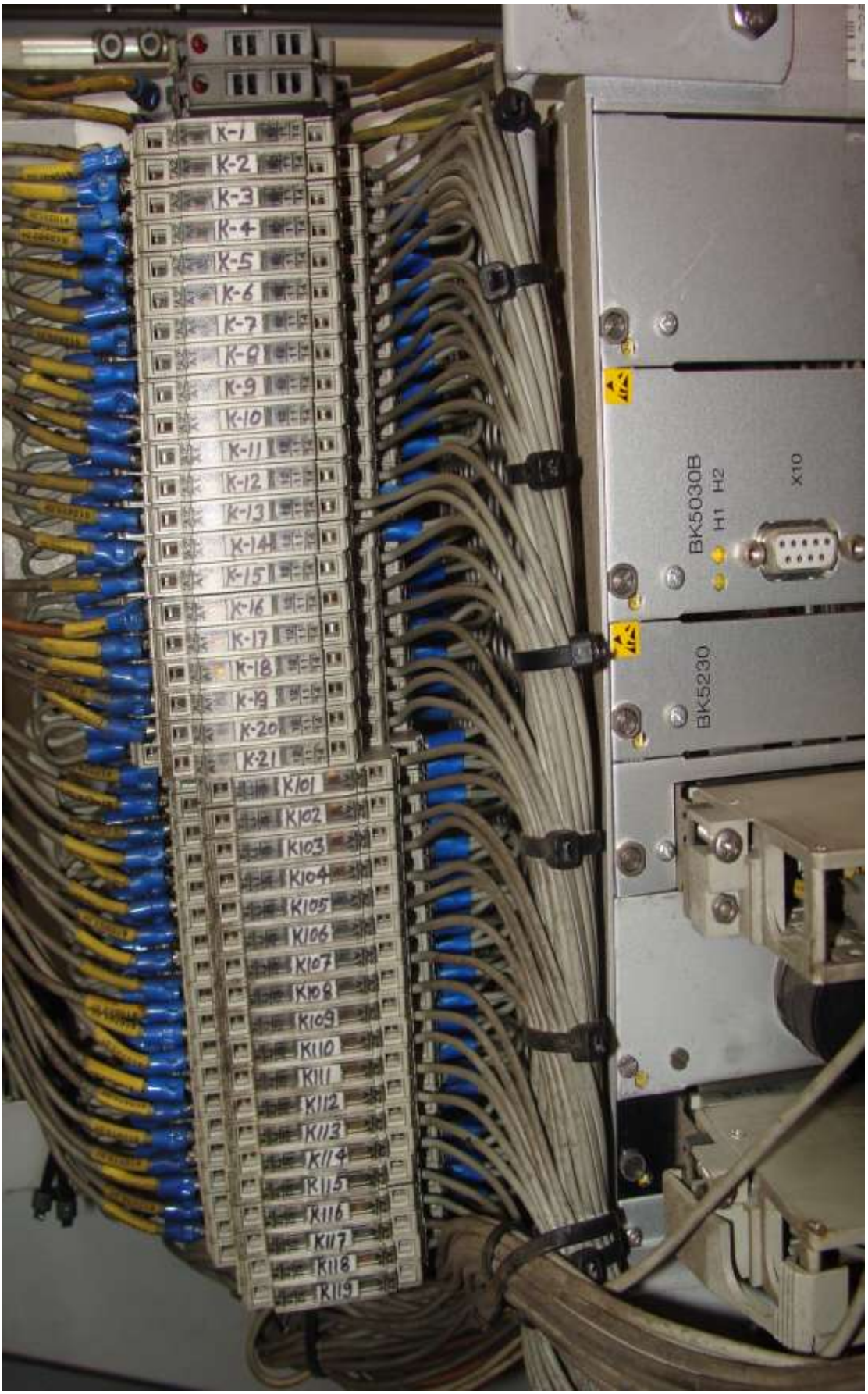
6.14 LAYOUT OF LEDS IN MICROPROCESSOR CONTROL UNIT

X 301								X 501		
1	O C	DIGITAL OUTPUT	O 1	Controller OK	Fault	O 11		DIGITAL OUTPUT	O C	6
2	O 1								O 11	5
3	O 2		O 2	Recirculation Air	Out Side Air	O 12			O 12	4
4	O 3								O 13	3
5	O 4		O 3	Ventilation Fan 1	Ventilation Fan 2	O 13			O 14	2
6	O 5								O 15	1
X 302			O 4	Not Active in System	Exhaust Fan	O 14		X 502		
1	O C	DIGITAL OUTPUT						DIGITAL OUTPUT	O C	6
2	O 6		O 5	Bypass Cooling 1/1	Bypass Cooling 2/1	O 15			O 16	5
3	O 7								O 17	4
4	O 8		O 6	Condenser Fan 1/1	Condenser Fan 2/1	O 16			O 18	3
5	O 9								O 19	2
6	O 10		O 7	Condenser Fan 1/2	Condenser Fan 2/2	O 17			O 20	1
X 701								X 702		
1	I 1		O 8	Compressor 1/1	Compressor 2/1	O 18			I 11	11
2	I 2								I 12	10
3	I 3		O 9	Compressor 1/2	Compressor 2/2	O 19			I 13	9
4	I 4	DIGITAL INPUT						DIGITAL INPUT	I 14	8
5	I 5		O 10	E.I. Heater 1	E.I. Heater 2	O 20			I 15	7
6	I C								I C	6
7	I 6		RUN :			STAT 1			I 16	5
8	I 7					STAT 2			I 17	4
9	I 8								I 18	3
10	I 9		I 1	Air - Co. 'ON'	400V OK	I 11			I 19	2
11	I 10								I 20	1
12	I C		I 2	Temp. Cond. Motor 1.1 OK	Temp. Cond. Motor 2.1 OK	I 12		X 104		
X 101								ANALOG INP 4....20 MA	+	
1	RES	NETWORK	I 3	Temp. Cond. Motor 1.2 OK	Temp. Cond. Motor 2.2 OK	I 13			-	
2	CH								+	
3	CL		I 4	Vent Motor 1 Fault	Vent Motor 2 Fault	I 14			-	
4	0V							X 403 X 402		
X 102			I 5	Temp. E.I. Heater 1 OK	Temp. E.I. Heater 2 OK	I 15		ANA LOG INPUT NTC		10
1	RES	NETWORK								9
2	CH		I 6	Low Pressure 1.1 OK	Low Pressure 2.1 OK	I 16				8
3	CL									7
4	0V		I 7	Low Pressure 1.2 OK	Low Pressure 2.2 OK	I 17				6
X 103										5
RS 232 C			I 8	Control Pressure 1	Control Pressure 2	I 18				4
X 104										3
1	+	SUPPLY 110V	I 9	High Pressure 1.1 Fault	High Pressure 2.1 Fault	I 19				2
										1
2	-		I 10	High Pressure 1.2 Fault	High Pressure 2.2 Fault	I 20		X 104		
								ANA LOG OUT	GND	2
									OUT	1

6.15 MICROPROCESSOR TERMINALS (HFG / LEEL MAKE)



6.16 MICROPROCESSOR TERMINALS (SIDWAL/Liebherr MAKE)



6.17 MICROPROCESSOR CONTROL UNIT

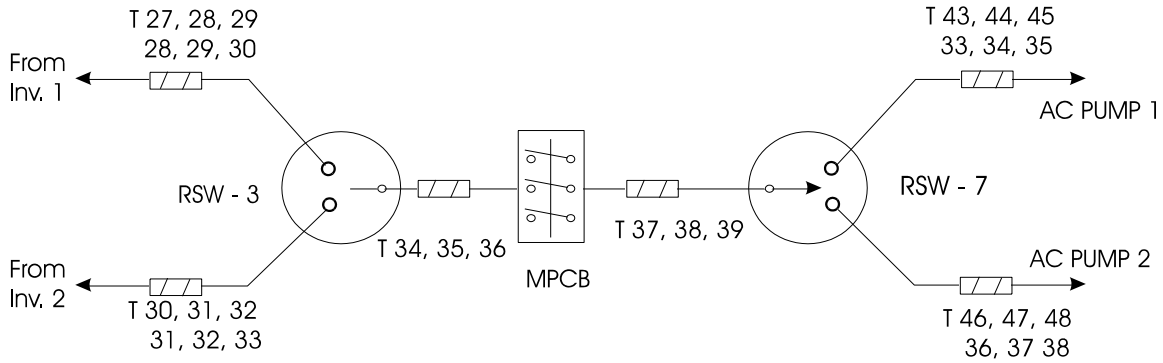
Lamp no.		Meaning of Display	Lamp no.		Meaning of Display
SID/Liebherr	**LHB/ LEEL**		**SID/lieb herr**	**LHB/ LEEL**	
K-118	**01**	Glows when controller is healthy	**K-119**	**011**	Glows for fault in AC system
K-116	**02**	Glows when Fresh/ Recirculating Air flap is set at Recirculating Air	**K-117**	**012**	Glows when Fresh/ Recirculating Air flap is set at Fresh Air
K-113	**03**	Glows when Ventilation-I is ON	**K-114**	**013**	Glows when Ventilation-II is ON
K-21	**04**	This indication is not for AC system	**K-115**	**014**	Glows when Ventilation-II is ON
K107	**05**	Glows during cooling operation indicates bypass cooling in Unit-I	**K-108**	**015**	Glows during cooling operation indicates bypass cooling in Unit-II
K-109	**06**	Glows during cooling operation indicates pressure switch functional when CD 1.1 in Unit-I starts.	**K-111**	**016**	Glows during cooling operation indicates pressure switch functional when CD 2.1 in Unit-II starts.
K-110	**07**	Glows during cooling operation indicates pressure switch functional when CD 1.2 in Unit-I starts.	**K-112**	**017**	Glows during cooling operation indicates pressure switch functional when CD 2.2 in Unit-I starts.
K-101	**08**	Glows during cooling operation indicates Comp 1.1 ON	**K-103**	**018**	Glows during cooling operation indicates Comp 2.1 ON
K-102	**09**	Glows during cooling operation indicates Comp 1.2 ON	**K-104**	**019**	Glows during cooling operation indicates Comp 2.2 ON
K-105	**010**	Glows during Heating operation indicates Heater-I, Unit-I ON	**K-106**	**020**	Glows during Heating operation indicates Heater-II, Unit-II ON
K-15	**I1**	Glows when AC system gets ON with switch **S1U4S1**	**K-16**	**I11**	Glows when 415V is OK
K-1	**I2**	Glows when winding temperature of CD 1.1 motor is within limit. This light goes OFF when winding temperature goes beyond limit & the motor also switches OFF.	**K-3**	**I12**	Glows when winding temperature of CD 2.1 motor is within limit. This light goes OFF when winding temperature goes beyond limit & the motor also switches OFF.

Lamp no.		Meaning of Display	Lamp no.		Meaning of Display
SID	**LHB/ LEEL**		**SID**	**LHB/ LEEL**	
K-2	**I3**	Glows when winding temperature of CD 1.2 motor is within limit. This light goes OFF when winding temperature goes beyond limit & the motor also switches OFF.	**K-4**	**I13**	Glows when winding temperature of CD 2.2 motor is within limit. This light goes OFF when winding temperature goes beyond limit & the motor also switches OFF.
K-13	**I4**	This is OFF when winding temperature of Ventilation-I motor is within limit. This light Glows when winding temperature goes beyond limit & the AC Unit-I also goes out of service.	**K-14**	**I14**	This is OFF when winding temperature of Ventilation-II motor is within limit. This light Glows when winding temperature goes beyond limit & the AC Unit-II also goes out of service.
K-17	**I5**	Glows when temperature of Heater-I, Unit-I is within limit. This light goes OFF when Heater temperature goes beyond limit & the Heater also switches OFF.	**K-18**	**I15**	Glows when temperature of Heater-II, Unit-II is within limit. This light goes OFF when Heater temperature goes beyond limit & the Heater also switches OFF.
K-6	**I6**	Glows when LP is OK. This light goes OFF when pressure at LP switch of refrigerant circuit 1.1 goes down and switches off refrigerant circuit 1.1 if the pressure remains low for more then 30 seconds.	**K-10**	**I16**	Glows when LP is OK. This light goes OFF when pressure at LP switch of refrigerant circuit 2.1 goes down and switches off refrigerant circuit 2.1 if the pressure remains low for more then 30 seconds.
K-8	**I7**	Glows when LP is OK. This light goes OFF when pressure at LP switch of refrigerant circuit 1.2 goes down and switches off refrigerant circuit 1.2 if the pressure remains low for more then 30 seconds.	**K-12**	**I17**	Glows when LP is OK. This light goes OFF when pressure at LP switch of refrigerant circuit 2.2 goes down and switches off refrigerant circuit 2.2 if the pressure remains low for more then 30 seconds.

Lamp no.		Meaning of Display	Lamp no.		Meaning of Display
SID	**LHB/ LEEL**		**SID**	**LHB/ LEEL**	
K-19	**I8**	Glows when Control pressure switch-1 is ON, which means HP is more then 25 bar which will automatically run second condenser motor.	**K-20**	**I18**	Glows when Control pressure switch-2 is ON, which means HP is more then 25 bar which will automatically run second condenser motor.
K-5	**I9**	This will Glow when HP gets more then setting of HP cut out switch 1.1 and the compressor 1.1, Unit-I will get OFF	**K-9**	**I19**	This will Glow when HP gets more then setting of HP cut out switch 2.1 and the compressor 2.1, Unit-II will get OFF
K-7	**I10**	This will Glow when HP gets more then setting of HP cut out switch 1.2 and the compressor 1.2, Unit-II will get OFF	**K-11**	**I20**	This will Glow when HP gets more then setting of HP cut out switch 2.2 and the compressor 2.2, Unit-II will get OFF

6.18 WORKING OF MONO-BLOCK PUMP FOR ENSURING WATER SUPPLY IN COACH

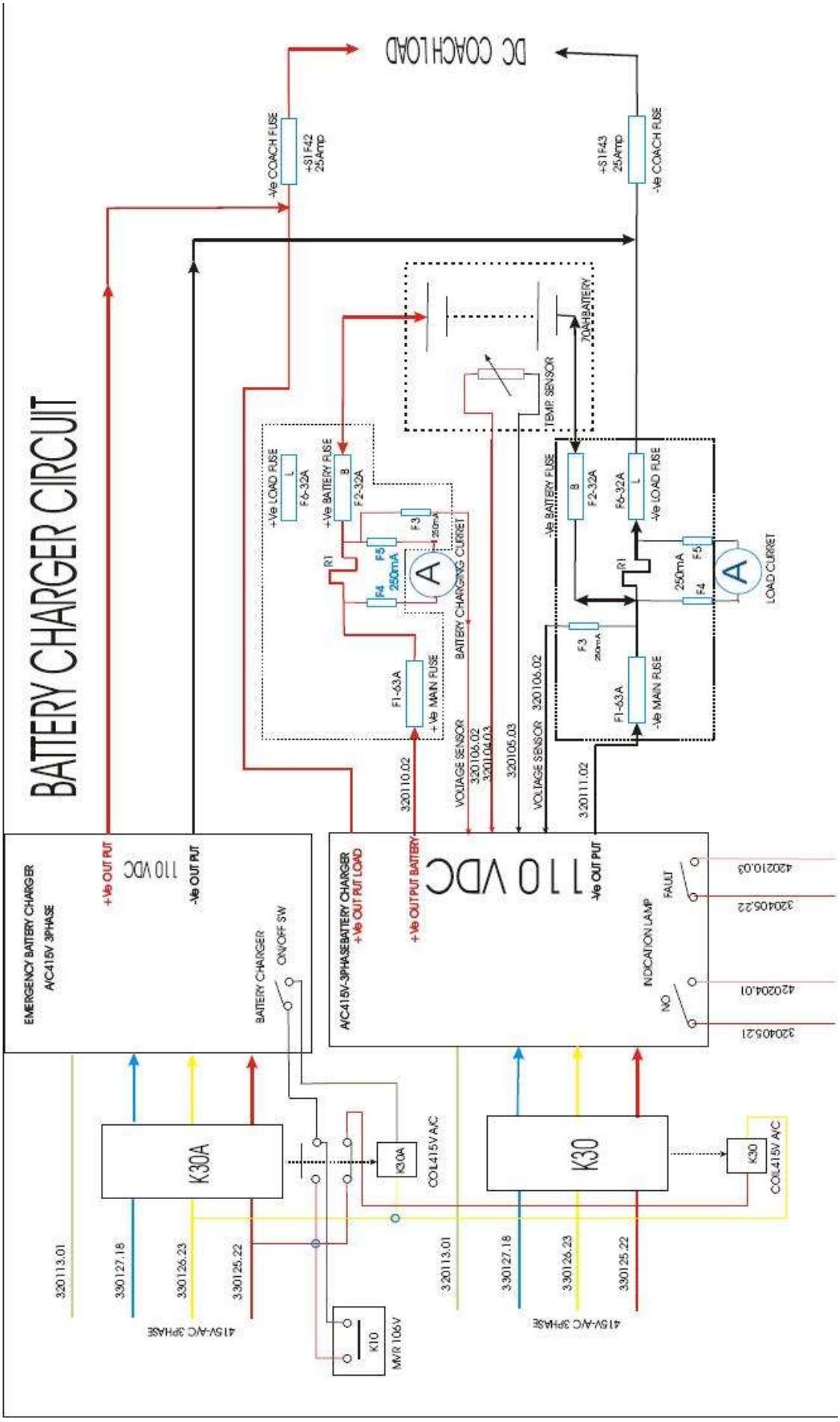
Water is pumped in the coach from under slung water tanks through Mono-block pumps. Equipment works continuously and water is pumped in a Auxiliary tank mounted over the toilets. The extra water overflows from Auxiliary tank to the main tank through a recycle pipe.

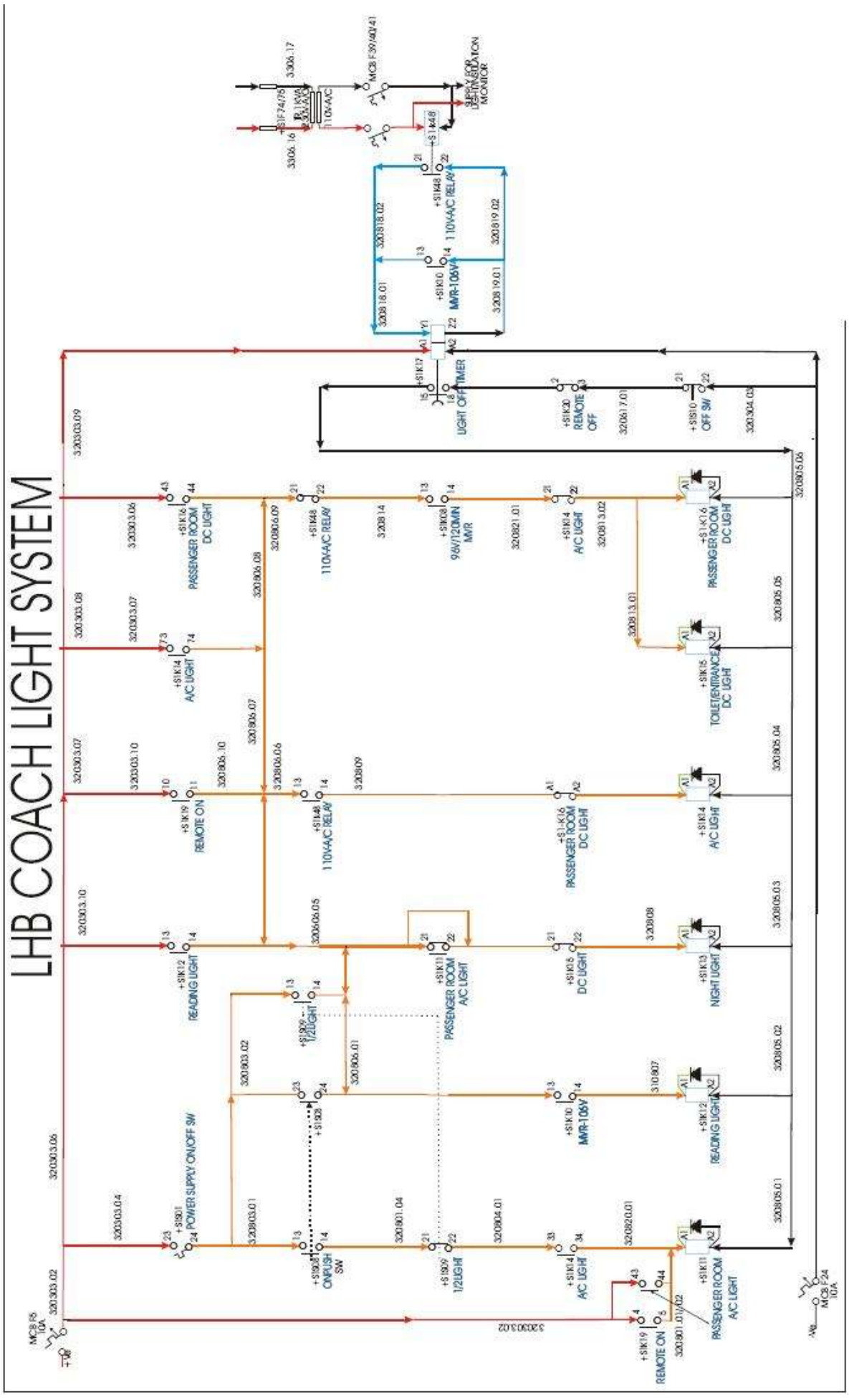


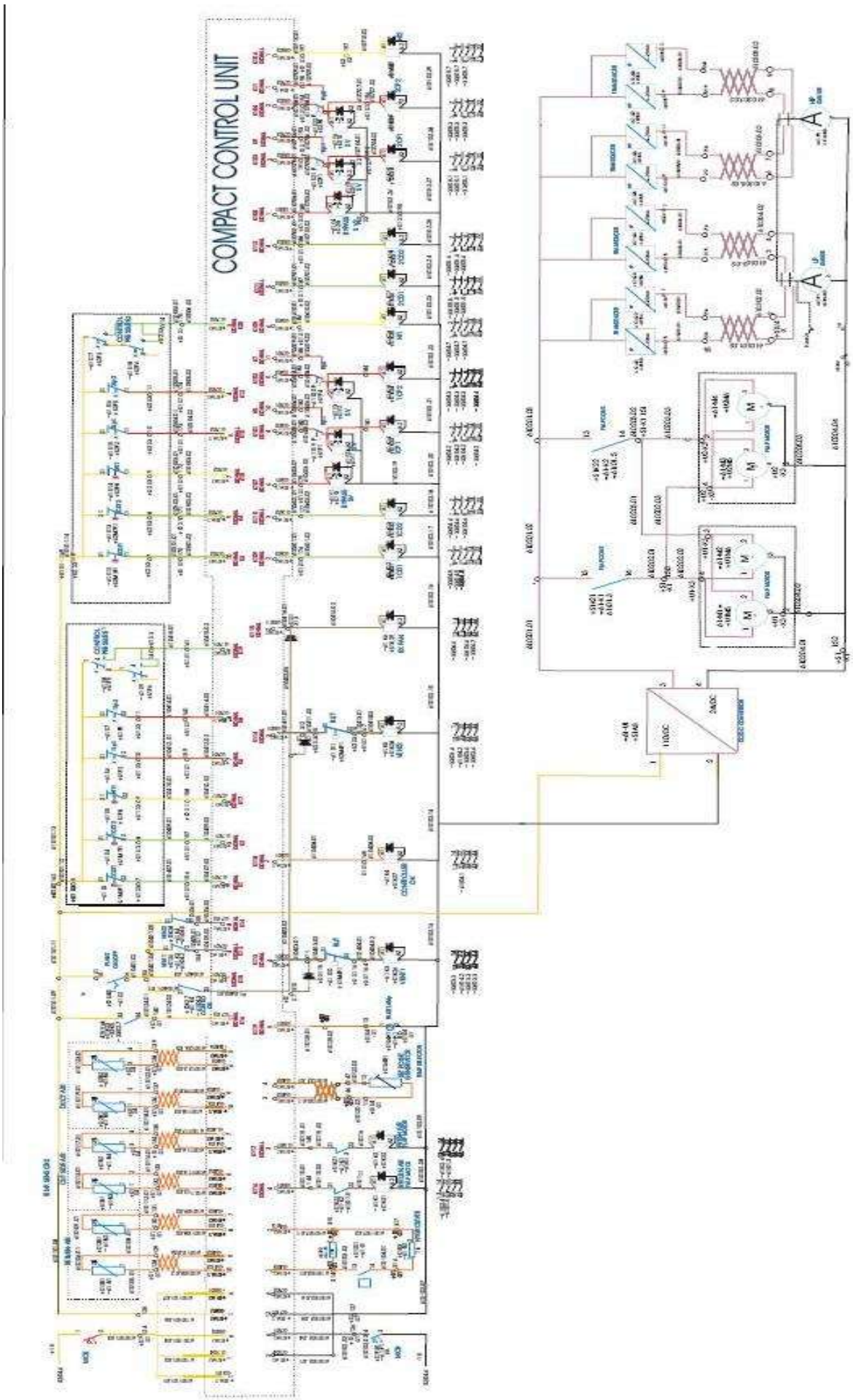
List of specifications for major equipment:

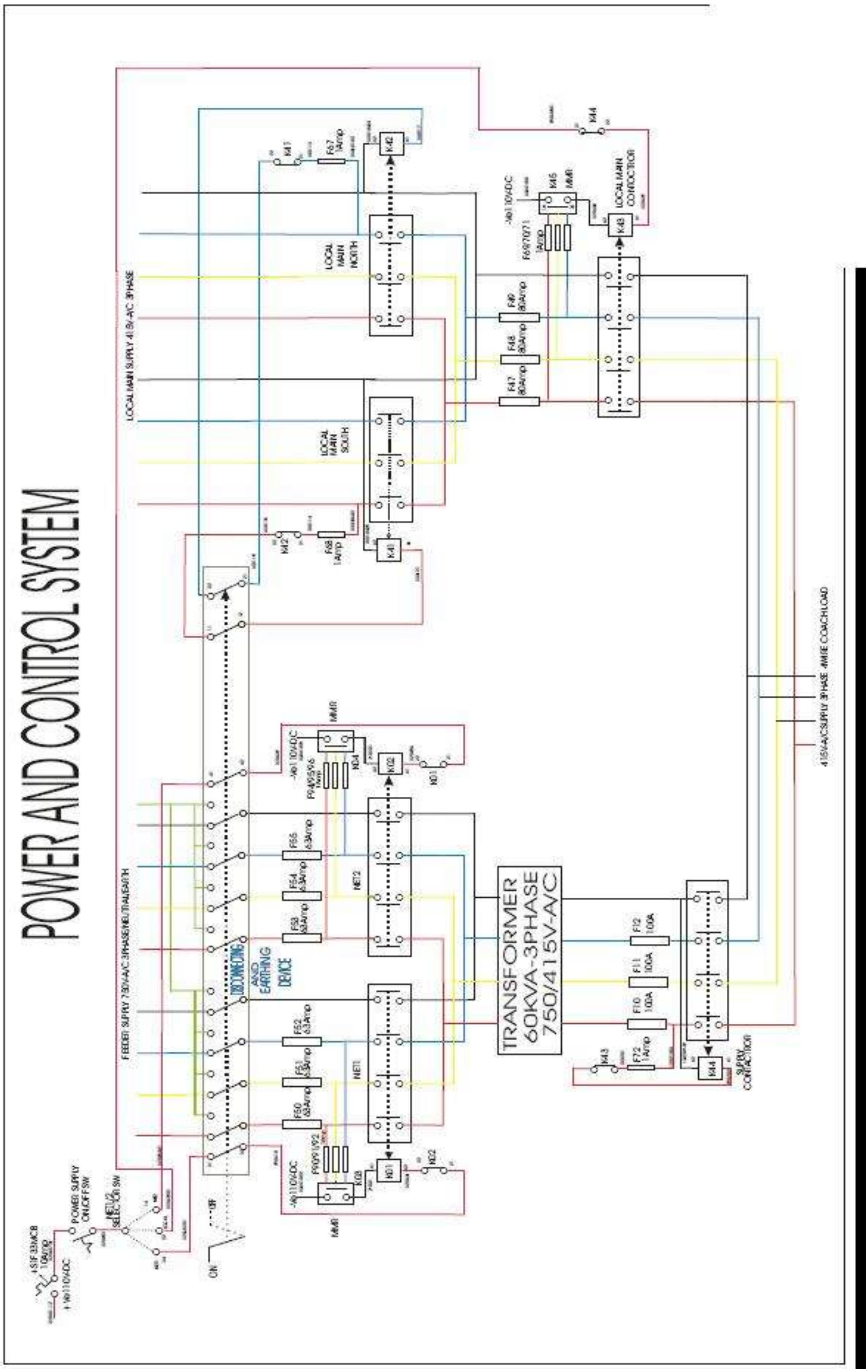
1. Roof Mounted AC Package unit RDSO/PE/SPEC/AC/0061
2. Switchboard Cabinet EDTS073
3. Regulated Battery Charger EDTS074
4. Emergency Battery Charger EDTS163
5. 60 KVA Transformer RDSO/PE/SPEC/0080

ANNEXURES


BATTERY CHARGER CIRCUIT
DC COACH LOAD
+Ve COACH FUSE
+S1 F42
25Amp
-Ve COACH FUSE
+S1 F43
25Amp
TEMP SENSOR
70AH BATTERY
+Ve LOAD FUSE
F6-32A
+Ve BATTERY FUSE
F2-32A
F3
F5
250mA
F4
250mA
A
BATTERY CHARGING CURRENT
R1
F1-63A
+Ve MAIN FUSE
-Ve BATTERY FUSE
-Ve LOAD FUSE
LOAD CURRENT
-Ve MAIN FUSE
320110.02
VOLTAGE SENSOR
320106.02
320104.03
320105.03
320111.02
EMERGENCY BATTERY CHARGER
A/C415V 3PHASE
+Ve OUT PUT
110 VDC
-Ve OUT PUT
BATTERY CHARGER
ON/OFF SW
A/C415V-3PHASEBATTERY CHARGER
+Ve OUT PUT LOAD
+Ve OUT PUT BATTERY
110 VDC
-Ve OUT PUT
INDICATION LAMP
FAULT
NO
420210.03
320405.22
420204.01
320405.21
K30A
K30A
COIL415V A/C
K30
K30
COIL415V A/C
320113.01
330127.18
330126.23
330125.22
415V-A/C 3PHASE
K10
M/R 106V
320113.01
330127.18
330126.23
330125.22
415V-A/C 3PHASE


LHB COACH LIGHT SYSTEM
MCB F30/40/41
POWER SUPPLY ON/OFF SW
ON/PUSH SW
1/2LIGHT
READING LIGHT
PASSENGER ROOM A/C LIGHT
PASSENGER ROOM DC LIGHT
A/C LIGHT
NIGHT LIGHT
TOILET(ENTRANCE) DC LIGHT
REMOTE ON
110V4A/C RELAY
96V/120MIN MVR
MVR-106V
LIGHT OFF TIMER
REMOTE OFF
OFF SW
MCB F24 10A
MCB I5 10A


COMPACT CONTROL UNIT


POWER AND CONTROL SYSTEM
TRANSFORMER
60KVA-3PHASE
750/415V-A/C
LOCAL MAIN NORTH
LOCAL MAIN SOUTH
LOCAL MAIN CONTACTOR
SUPPLY CONTACTOR
DISCONNECTING AND EARTHING DEVICE
NET1
NET2
FEEDER SUPPLY 750V-A/C 3PHASE/NEUTRAL/EARTH
LOCAL MAIN SUPPLY 415V-A/C 3PHASE
415V-A/C SUPPLY 3PHASE 4WIRE COACH LOAD
POWER SUPPLY ON/OFF SW
NET1/2 SELECTOR SW
MMR
ON
OFF

ANNEXURE

DOUBLE DECKER EOG AC CHAIR CAR

INTRODUCTION

The double-decker trains are designed indigenously by Rail Coach Factory, Kapurthala in association with RDSO, Lucknow. The train consists of AC double-decker chair car coaches, with 120 seats in each coach. It has increased the passenger carrying capacity appreciably. Space for the two decks has been generated by using the space between the two bogies. The base of the coach is also below the platform level. **Code for double decker ac chair car over Indian Railways is LWCZDAC**

It is using End-On-Generation system. The power for train lighting and air-conditioning is supplied by power cars at each end of the rack equipped with diesel generating sets at 750 volts, 3 phase and 50Hz ac supply.

External View of Double Decker Train

Internal View of Lower Deck

COACH SUPPLY SYSTEM

The EOG supply system is same as in the case of LHB EOG coaches. In these coaches 2 nos. each 60 kVA step down transformers are provided for stepping down 750 V, 3 Φ AC, 4 wire, 50 Hz supply to 415 V, 3 Φ AC, 4 wire, 50 Hz supply. Each of these two transformers feed coach load and half AC load.

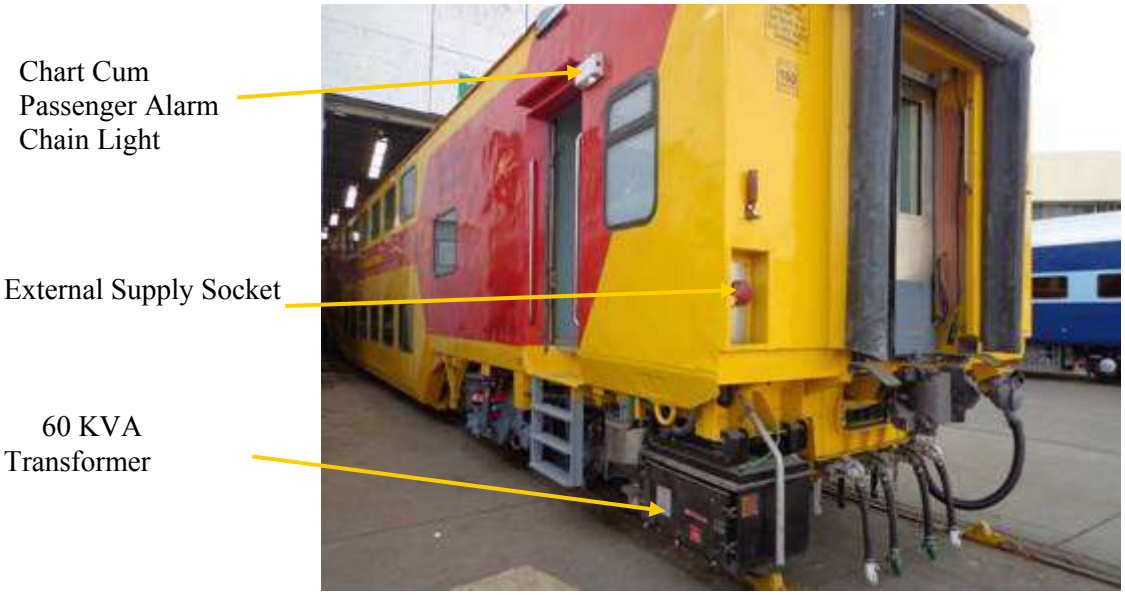


Figure : Outer View of EOG AC Chair Car

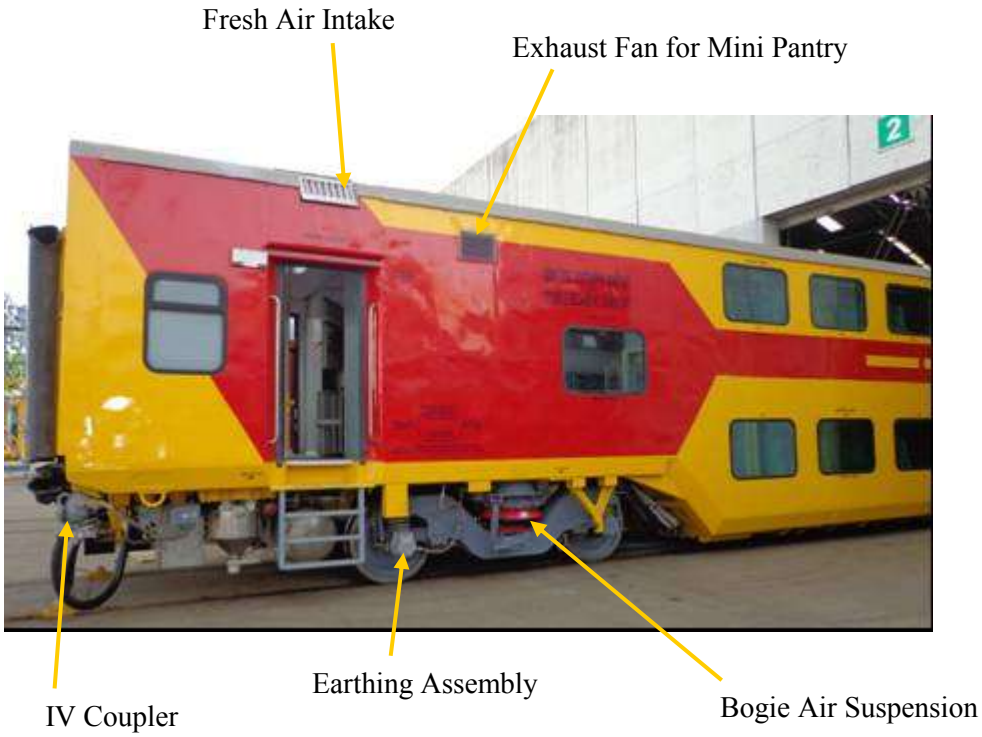


Figure : Outer View of EOG AC Chair Car

ELECTRICAL FEATURES OF DOUBLE DECKER AC CHAIR CAR

(i) Features which are same as in LHB EOG AC coaches

- IGBT based battery charger.
- Micro-controller based Roof Mounted Package Unit (RMPU) for Air Conditioning.
- Microprocessor based pump controller unit.
- Integrated, modular single Switch Board Cabinet with controls of AC, lighting & pantry etc.
- Provision of Dry type Transformer without encapsulation
- Modular and elegant interior light fittings and reading lights.
- Integrated modular pantry unit.
- Provision of electron beam irradiated cables.
- Provision of Measuring and Monitoring relays in Feeder circuit.
- Online insulation monitoring.
- Uniformity of illumination.
- Wheel set earthing equipment for high life of axle bearings.
- Provision of earthing and disconnecting device.
- Cable protection system with IP-67 protection and UL-94 V0 fire retardancy.
- Screw less, modular elegant switches.
- Provision of Emergency Battery charger.

(ii) Additional features which are different from LHB EOG AC coaches

- RMPU capacity increased from 7 TR to 10 TR, and the refrigerant used is R 407 C, eco- friendly refrigerant.

- nos. 60 kVA step-down transformers are provided in each coach. These are **shifted towards ends of the coach**. The 750 volts, 3-phase, 50 Hz input is stepped down to 415 volts 3-phase, 50 Hz and fed to the 415 v supply system of the Double Decker coach.

60 kVA Transformer

- nos. water raising mono-block pump assemblies are provided for raising the water to the coach which operates on 415v, 3-phase, 50Hz ac supply. These are **shifted behind stairs of the coach**.

Mono block pump set

- 70AH lead tin/VRLA sealed maintenance free (SMF) battery has been housed inside the coach in upper-frame near down stairs at PP end.

Batteries

- Battery fuse is integrated in Switch board cabinet inside the coach PP end.

- Modular Pantry has been specially designed and provided in each coach to meet the requirements of IRCTC for catering the passengers according to available space. In this water bottle cooler designed for keeping 1 litre bottles is provided in addition to RO water purifier.

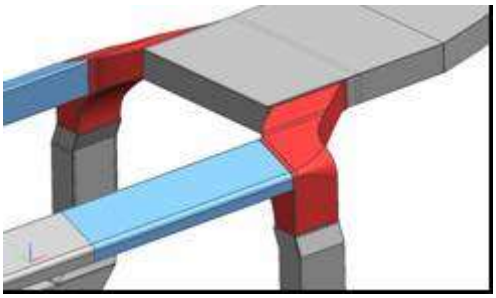
- Mini Pantry

Hot Case

Bottle cooler/Deep Freezer

RO Water Purifier

- As the space for ducting in the centre of the coach was not available, specially designed ducting along the sidewall has been provided for upper and lower deck.



- A Passenger Alarm Coach Indication Light (PACIL) circuit along with pull chain is also provided in Double Decker coach for the use of passengers to stop the train in case of any emergency.

PACIL

- Door opens automatically with the push of a button and closes automatically after preset time. If door opening obstructed by passenger, it remains open. In case of power failure door operates manually.

- Mobile charging sockets are provided in each bay

- Fire & Smoke Detection & Early Warning system has been provided.

- G.I. conduits have been replaced with aluminium conduits for under-frame equipment to overcome the problem of voltage drop in the coaches.

DESCRIPTION OF DIFFERENT COACH EQUIPMENT

These coaches are equipped with the following equipment:

Switch-Board Cabinet

Switch Board cabinet is designed with up-rated switchgear and additional integration of battery fuse in it. This modular, integrated single cabinet designated switch board cabinet comprises all necessary equipment for control and protection of following coach systems:

- Microprocessor based Heating, Ventilation & Air conditioning
- Lighting
- Pantry
- Anti skid protection
- Public Address system
- Sanitary system (except W.C. control)
- Regulated IGBT based Battery charger
- Disconnecting and earthing device.
- On-line insulation monitoring relays

Control unit for AC package and pantry

Lavatory panel light control

Switch board control panel

Control unit for main feeder supply and network

Control unit for water pump

MICROPROCESSOR CONTROLLED AC PACKAGE UNIT (RMPU TYPE)

Two nos. microprocessor controlled AC package units, each having **10.0TR capacity** are provided in each coach at the ends. The AC package unit is provided with vapour compression refrigeration system R 407C or any other eco friendly refrigerant having A1 safety category with zero ODP as per ASHRAE standard. These AC units are designed as per RDSO spec. no. RDSO/PE/SPEC/AC/0134-2009 (Rev.0) with amendments 1, 2, 3.

CONDENSER FANS AIR INTAKE FOR CONDENSER FANS

Figure 6.9 Roof Mounted AC Package Unit

Each air conditioning package unit has two separate cooling circuits consisting of following components:

1.	Hermetically sealed scroll compressors	-	Two (nos.)
2.	Condenser coil unit	-	Two (nos.)
3.	Condenser fan unit	-	Two (nos.)
4.	Condenser fan impeller	-	Two (nos.)
5.	Condenser fan motor	-	Two (nos.)
6.	Evaporator cooling unit	-	Two (nos.)
7.	Evaporator blower motor	-	Two (nos.)
8.	Evaporator blower fans	-	Two (nos.)
9.	Filter dryer	-	Two (nos.)
10.	Pressure switch 23/20 bar	-	Two (nos.)
11.	Pressure sensor 0-10 bar	-	Two (nos.)
12.	Fresh air filters	-	Two (nos.)
13.	Pressure switch 0-40 bar	-	Two (nos.)
14.	Over heat protection switch for heater	-	One no.
15.	ESTI-1 cartridge +130 degree C for ultimate disconnection of power supply	-	One no.

16.	Solenoid valve	-	Two (nos.)
17.	Anti vibration mounting pads	-	06 nos.
18.	NTC temperature sensor	-	03 nos.
19.	Thermostatic expansion valve suitable for automobile application	-	02 nos.
20.	Hygrostat (30-100%rh)	-	01 no.
21.	Three phase stainless steel heater elements without fins each 6 kW capacity	–	1 set
22.	Stainless steel drip trays complete with arrangement for drainage of condensate water	–	02 nos.
23.	Compressor anti vibration mounting	-	as reqd.
24.	Condenser motor anti-vibration mounting	-	as reqd.
25.	Liquid receiver	-	as reqd.
26.	Return air filters	-	02 nos.
27.	Power & control connectors (M/F) along with accessories	–	one for power and one for control supply

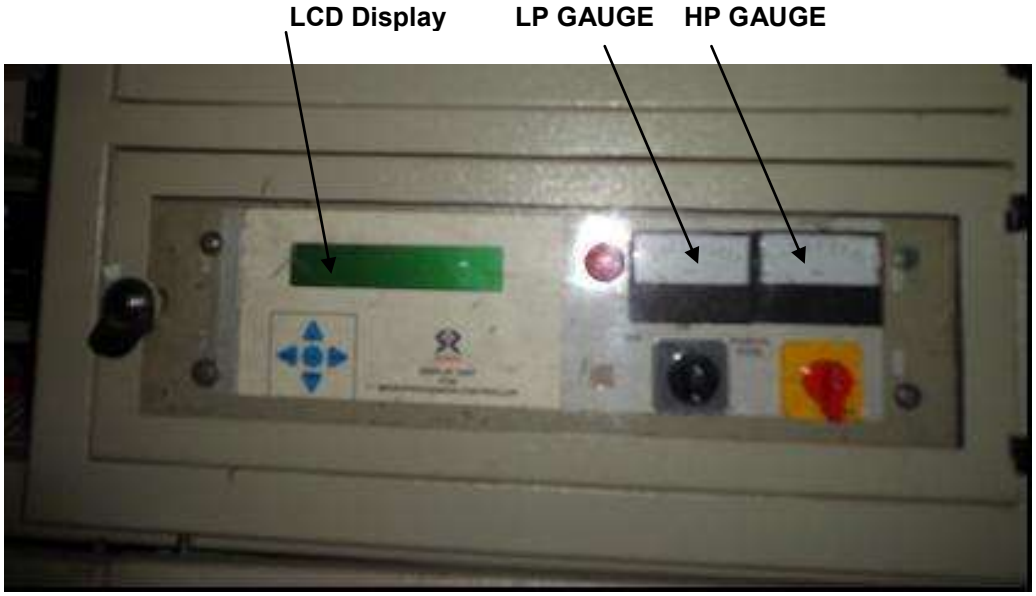
MICROPROCESSOR BASED CONTROLLER FOR RMPU

The control and regulation of both RMPU is performed by one microprocessor controller, which is located in switch board cabinet. This is designed as per RDSO specification no. RDSO/PE/SPEC/AC/0139- 2009 (Rev.0).

Figure: Microprocessor Based Controller for RMPU

MICROPROCESSOR CONTROL PANEL

The control panel for RMPU is provided with LCD display and it works on 110 V dc ± 30%. It is installed in switch board cabinet. Switch panel is as per RDSO drawing no. RDSO/PE/SKAC/0125/2009 (Rev.0). There is a rotary switch on switch panel for putting the unit in manual mode in case of emergency.



RATINGS OF IMPORTANT EQUIPMENT

SN	Equipment	Rating	Qty/ Coach
1	Step down Transformer	3 Ø, 750 V/ 415V AC, 60kVA	2
2	Battery	70 Ah, 12 V Mono-block, VRLA SMF	9 Mono blocks
3	Sealed Compressor	3 Ø, 415 V AC	4
4	Condenser Motor	1 HP, 3 Ø, 415 V AC	4
5	Blower Motor	1.5 HP, 3 Ø, 415 V AC	2
6	Condenser Coil	Fin on tube type	4
7	Cooling Coil	Fin on tube type	4
8	Heater Unit	3 Ø, 415 V AC, 6 kW	2
9	Mono-block Pump	3 Ø, 415 V AC, 0.5 HP	2
10	Emergency Battery Charger	Input : 230V±5%, 1 Ø Output : 110 V DC	1
11	Regulated Battery Charger	Input: 415V, 3 Ø, AC Output: 110 V DC	1

LIGHT FITTINGS

Light fittings are provided with injection moulded and extruded diffuser for defused lighting with uniformity of illumination and lumen as per UIC. These fittings are screw less and press fit type. Vestibule, toilet, pantry and emergency lighting works at 110V AC /DC with inverter and poly carbonate diffusers. Complete lighting is with high frequency ballast (58 kHz) for flicker free comfort lighting.

COMPARTMENT LIGHT FITTING

Provision of central ribbon type light (T-5 fluorescent tube) for both the decks (flush type) .

Vestibule and Emergency light fitting

Figure Vestibule and Emergency Light Fitting

Toilet light fitting
Toilet Occupancy Indicator

FigureToilet Light Fitting

FigureToilet Occupancy Indicator

PRODUCT LIST FOR DOUBLE DECKER EOG AC CHAIR CAR

S. No.	Description	DRG./SPEC./CAT. NO.	QPC
1	Roof mounted AC package unit for double Decker EOG type coaches	RDSO/PE/SPEC/AC/0134-2009 REV-'0' RCF AM-3	2
2	Switch board cabinet for double Decker EOG type coaches	EDTS327, REV-A, AM-1 CORR-1	1
3	Vestibule light fitting single for LHB type coach	LW76004b	2
4	Ceiling light fitting double for LHB type coach	LW76011c	6
5	Ceiling light fitting double for double Decker EOG type coaches	LW7655d	17
6	Lavatory light with CFL for LHB type coaches	LW76033 ALT-'D'	4
7	Passenger alarm coach indication light (for LHB type coach)	LW76005e	2
8	WC gauge signal light assembly	LW76006c	2
9	Electronic ballast for light fittings	EDTS-092	
10	Emergency light system for EOG type LHB coaches	EDTS151, REV-'C' AM-2	2
11	Fluorescent lamp 18 w	RDSO/PE/SPEC/D/TL/0011-2000, REV-1, SEC-1 (JULY-1), AM-1	10
12	Fluorescent lamp(t5)-14 w	M/S OSRAM/PHILLIPS	34
13	Razor socket for WC 110v/24v	EDML047, ITEM-4	4
14	Terminal connector	EDML037, REV-A	4
15	PVC rigid conduit, fire retardant	IS:9537-83, P3, CL.5.1	
16	Polyamide flexible conduit	RDSO/PE/SPEC/AC/0138-2009 (REV-1)	****
17	Emergency battery charger	EDTS163, REV-C, Corr-3	1
18	Passenger information system for ac & non-ac coach	RDSO/PE/SPEC/AC/0087-2008(REV-0)	1
19	Material list for switch plates	EDML-064, TAB-1, REV-A	1
20	Composite pantry for double Decker EOG type coaches	EDTS-329, REV-D	1
21	Single inlet radial blower 415v, 3 phase, 50 HZ, 185w, 1045 cu.mtr./hr discharge for exhausting air	EDTS331, TYPE-2, CORR-1 & 2	1
22	120 sq.mm. Thin walled flexible elastomeric cable with cu. Cond. Above 750v to 1.8/3.0 kv	ELRS/SPEC/ELC/0019, REV.2	****

S. No.	Description	DRG./SPEC./CAT. NO.	QPC
23	Electron beam irradiated multicore cable 600/1000v	EDTS-132, REV-C, AM-3	****
24	60 kva transformer	RDSO/PE/SPEC/AC/0080, Rev'0'-2007, Am-2 with RCF Corr. 1, 2 & 3	2
25	Self priming monoblock assembly with controller	EDTS186, Rev 'A' , AM-2	2
26	Constant voltage regulated battery charger	RDSO/PE/SPEC/AC/0129-2009 REV '1'	1
27	Zs coupling 400a, 750v, 3-phase, 50hz	EDTS105, REV-E, AM-2, Corr 1, Type-1	1
28	Valve regulated lead acid batteries for 110v train lighting air conditioned and lhb coach	RDSO/PE/SPEC/AC/0009-2008(REV-1)WITH AM-1, RCF ANNX-A	1
29	Wheel set earthing equipment	EDTS101, REV-C, AM-1	2
30	Feeder junction box for LHB type EOG coach	EDTS328, REV-C, AM-1	1
31	Battery fuse box +ve	LW71001	1
32	Battery fuse box -ve	LW71002	1
33	Plug & socket distribution board 20a, 240v single ø ac	LA72200a	2
34	Mobile/laptop charging socket	CAT. NO. –EL243	34
35	Pa system for LHB EOG Rajdhani rake	EDTS173, REV-A, AM-3	1
36	External supply plug 125a, 415v, ip-67, 5 pole (3p+n+e) with pilot contacts	1945436/PV4125-6	1
37	External supply socket 125a, 415v, ip-67, 5 pole (3p+n+e) with pilot contacts	1948036/UIV4125-6	2
38	Double inlet centrifugal blower assembly	EDTS331, REV-0, Corr.1 & 2	2

NOTE

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CHAPTER 7

EOG POWER CAR

7.0 INTRODUCTION

The Rajdhani / Shatabdi rakes work on the principle of End-On-Generation system i.e. provision of two power cars, one on the front and other on the rear. Each power car is equipped with two Diesel Alternator sets to supply Electrical load to the coaches through two set of feeders running along the rake and coupled in between with the help of inter-vehicle couplers. These couplers also carry the earth wires and 2 wires for the control circuit.

Presently the diesel alternator set provided in the power cars is the uprated version, EPCB norms compliant engine with and installed capacity of 490 BHP at 60 degrees at 1500 rpm

7.1 DIESEL ENGINE

The Diesel Engine provided is turbo charged , water cooled delivering 490 BHP at 60 DegC at 1500rpm coupled to 500 KVA alternators. These powers cars meet the various loads for the coach including the pantry equipment and air conditioning load of the coaches..

At present there are following makes of Diesel alternator sets provided on the LHB Power Cars

1. BHEL-EML (formerly KEL, Cochin, taken over by BHEL)
2. Kirloskar Electric Company, Bangalore
3. Deev Gensets, Silvasa
4. Cromptom Greaves

The engine provided by M/s Cummins i.e. to cat no KTA19G5I is CPCB (Central Pollution Control Board, Ministry of Environment and Forests) compliant as regard to emission norms as certified by Automotive Research Association of India (ARAI), Ministry of Surface Transport

The diesel alternator sets generally conform to the details as indicated

Output Power	:	500 KVA at NTP
System Voltage	:	750 volts AC , 3-phase
Frequency	:	50 Hz +\- 3 %
Power Factor	:	0.8

Various makes and their catalogue nos. are as indicated below

DA set make	Engine make & model	Alternator make & type
BHEL-EML (formerly KEL)	Cummins – KTA 19G5I	BHEL – Type -ARES Model – 3560 L7 SP
Kirloskar (KEC)	Cummins – KTA 19G5I	KEC – 4AB355/7
Crompton Greaves	Greaves Cotton TBD41V12P	CG model 355 MA

7.1.1 Alternator

The alternator provided has a capacity of 500kVA, 0.8 pf 3phase, 4 wire 750 volts 50 HZ +\- 3 %. The alternator used is self ventilated brushless design with voltage regulation of dual type i.e both electric and electronic. The electrical control is through compound transformer or magnetic amplifier and electronic regulation through solid state automatic voltage control and sensing from all the three phases. The combined regulation is 2.5 % approximately. Standby facility is provided to ensure voltage regulation within 5 % even in the event of failure of automatic voltage regulator and this standby facility is automatically cut in with the help of OVR/UVR which indicates through two LED"s of the failure of AVR and that the system is in manual mode

Automatic voltage regulator is suitably mounted in the power panel. The alternator has a stator, rotor insulation of H class and exciter insulation class F. The alternator is capable of handling 30% unbalance load in any of the phases with current in any of the phases not exceeding the rated current with regulation maintained at 5% or less or 2.5% or better in manual and AVR mode of operation respectively.

Alternator is designed such that the total harmonic distortion is below 5% of the rated capacity. Alternatively a neutral reactor 125 volts, 50 amps, 150 Hz is to provided in LHB coaches.

7.1.2 Layout

The Diesel alternator sets are placed back to back at the centre of the coach. Layouts for the LHB type coaches is as per drawing no. LP90100.

7.1.3 Engine Cooling

The engine is water cooled and supplied with radiator suitable for separate mounting at a remote location to facilitate cooling by fan directly driven by 40HP, 3-phase, 415 volts, 50 Hz motor wherein the impeller sucks in outside air through the radiator fins and blows out upwards through the duct to the roof. Air delivery is approximately 18 cubic metre per sec. at 60 mm water gauge.

7.1.4 Exhaust Arrangement

The exhaust outlet locations are fixed for all makes of the engine such that the silencer provided on the specially designed dished roof portion is connected by means of flexible metal hose to the engine which is lagged and enshrouded all round with aluminium sheet to provide a positive and effective thermal insulation. The outer surface of the silencer is treated with special process of aluminium metallising as an anti-corrosive measure.

7.1.5 Fuel System

Two under-slung fuel tanks are provided in the underframe with an individual capacity of 1540 liter. The engines are fed through respective tanks and the tanks are connected through an equalizing pipe with a cut off valve in-between.

7.1.6 Engine Room Ventilation

Two centrifugal type blowers per DG set are provided at the cant rail level of capacity 25000 CMH at 30mm WG each are provided such that the air is drawn from the engine room through the opening on the false ceiling and blown out laterally through rectangular louvered openings provided on either side on the sloping roof sheet. To minimize the air dust ingress in the engine room four hatch door louvered openings with dry type re-usable, fire retardant, non-woven synthetic media with a filtering capacity of upto20microns are provided. The blowers are driven by 415volts, 3-phase, ac motors of 5 KW.

7.1.7 Engine Room Filters

To minimize the dust into the engine room through the four hatch doors louvered openings, dry type, re-usable fire retardant, non-woven synthetic media panel filters, with a filtering capacity of upto 20 microns size dust particles have been used for both LHB and Garib Rath power cars. Each filters module comprises of 9 detachable panels

7.1.8 Fuel Transfer Pumps

The engine installed by Greaves Cotton has a fuel pump provided to suck the fuel from the diesel tanks provided at the bottom

7.1.9 Battery

For starting the engine 290 Ah Lead acid battery is provided to feed the power to the engine starter motor for cranking one engine at a time by means of changeover switch for the two DG sets.

7.2 BASIC FEATURES OF POWER CAR

S.No.	Particulars	Power Car
1	Coach length	23.5 meters
2	Speed potential	160 kmph
3	Roof Mounted AC Unit	1x7Ton
4	No of Transformers	3 x 60 KVA, star-star
5	Pump equipment	One set of two pumps
6	Pump controller	Provided
7	Water storage tank	1 x 685 litres
8	Engine	2 x 490 BHP
9	Alternator	2 x 500 KVA at NTP
10	Radiator fan	2 x 40 HP
11	Ventilation fan motor	4 x 7.5 HP
12	Starter battery	2 x 290 Ah
13	Smoke detector	Provided
14	Temperature controller	Fine control in5 steps
15	Humidity controller	Provided
16	Window size	Bigger
17	Anti-skid device	Provided
18	Braking	Disc braking
19	IGBT battery charger	Provided
20	Battery	70 Ah for DC control of power panel
21	Disconnecting and earthing device	Provided
22	Transformer fuse	Provided inside the power panel
23	Insulation monitoring device	Provided
24	Self diagnostic system	Provided
25	Flap motor to adjust fresh air	Provided
26	Temperature sensors	NTC type
27	Suction discharge pressure indicated on panel	provided

7.3 PROTECTIONS

The diesel alternator set for the power cars are provided with various protections and safeties for the safe working of the rakes

7.3.1 For Diesel Engine

- **High water temperature**:- The high water temperature switch is mounted on the engine and senses the temperature of water in the cooling jacket of the engine. The device is set at 97 Deg.C for putting off the engine. Once the ICHT closes, water temperature indication comes on and the common fault relay is energized

- **Over speed of the engine** :- over speed switch ICOS mounted on the engine senses the over speed when the engine governor fails. When the engine RPM exceeds the set value its NO contact closes the over speed relay OSR. One of the NO contacts of the OSR maintains the supply to OSR and another contact closes and completes the CFR circuit. The over speed is set at 1800 ± 4.5 % RPM

- **Lube Oil Pressure** :- The lube oil pressure switch is mounted on the engine senses the lube oil pressure. The NC contact of the lube oil pressure switch remains open when the lube oil pressure is sufficient. When the pressure is below the set value, the switch closes the LOP relay. One of the NO contacts of the LOP maintains the supply to LOP relay and another NO contact energizes the CFR circuit.

  At the time of starting one of the NC contact of the start push button opens the LOP circuit. It is a positive interlock that ensures that the engine does not stop for the want of lube oil pressure build up at the moment of starting. A delay contact of the Time delay relay for the starter solenoid (FSRD) relay keeps the LOP circuit closed. Once engine starts, the lube oil pressure develops, opens the oil pressure switch ICLOP (Internal Combustion Engine Low Oil Pressure) which keeps the LOP de-energised as long as there is sufficient pressure of the lube oil. The permissible limits for Cummins engine is 3.16-6.33 kg/sqcm.

- LOW WATER LEVEL SWITCH:- A low water level switch has been provided on the top of the radiator for sensing the presence of water in the radiator. If ever the water level goes down below a certain level, it gives a indication on the panel and the same can be integrated in the panel control circuit for switching off the load or the engine

7.3.2 Alternator Protection

- **Alternator Overload**: - This protection is in-built in the ACB. The ACB has an integrated solid state relay of thermal overload type which incorporates the following precautions:-
    1. Short circuit
    2. IDMT and Overload
    3. Earth Fault

  Whenever the fault conditions are sensed, IDMT relay picks supply to the alternator fault relay. The ACB provided is to cat no. CNCS800 of M/s L&T/ cat no S800 of M/s GE with and without microprocessor control based protection measurement and communication unit to catalogue no RMS-9D of M/s GE or equivalent.

- **Under voltage relay**:- When the voltage of the alternator falls below the set value of 687 volts (380 at 415 volts side). The NC contact of UVR closes on due to dropout of UVR and energizes the time delay relay. The ON delay contact of the timer closes after few seconds and energizes the AFR. The NO contact of the AFR energizes the auxiliary relay of the ACB (24 volts DC) and this relay de-energizes the 415 volts trip relay of the ACB resulting in tripping of the air circuit breaker. The relay is supplied by M/s NOVAGO, Chennai. The technical details are as under:-

  Auxiliary voltage – 440 v ac

  Contact rating 2 amps inductive at 24 V dc

  Monitoring system voltage 750 volts, 3 phase, 50 Hz, 4-wire

  Contacts 2 N/O + 2 N/C independent

- **Earth Leakage Relay**: - The relay supplements the earth leakage feature already incorporated in the solid state or thermal type relay of the ACB. Core balance transformer operated earth leakage device detects any earth fault caused either in the alternator winding or in the cables from the alternator to the control panel upto the core balance transformer.

  Its NO contact energizes the earth leakage relay ELR. One of the NO contacts of ELR energizes the Earth fault indication lamp and AFR circuit. Another NO contact of ELR maintains the supply to ELR itself, even after ACB has been switched OFF. This protection is mainly for the alternator / interconnecting cables between the ACB and the alternators.

  The technical details are as under:-

  a. Size of cable – 150 sqmm
  b. Auxiliary supply voltage – 440 volts ac
  c. Contact arrangement 1 N/O + 1 N/C independent
  d. Contact rating 230volts 50 Hz, 5 amps, ac resistive
  e. Suitable for 750volts, 3 phase, 50 Hz, 4-wire system

- **Short Circuit**: - This feature is incorporated in the ACB .This results in the instantaneous tripping of the ACB, when set value of the current is sensed.

7.3.3 Feeder Protection

The two individual feeders are protected by individual contactors, with the following trips

- **Earth Leakage** :- The protection scheme for the conventional (3 wire system) and LHB type (4 wire system) relay is different

- **LHB Type Power Cars**:- These Power cars are equipped with residual current type relays of BENDER make.

- **Feeder Overload :-**

  LHB POWER CARS: - The relay provided for the protection was originally of ZAHRA make which was finally changed to MICOM make due to malfunctioning. The MICOM make relay is Universal programmable relay which can be programmed to suit to the usage. The relay is used an over current relay to protect the feeder.

7.4 OPERATIONAL SAFETY AND PROTECTION IN POWER CARS

7.4.1 Plant selection

A plant selection switch has been provided on the Switchboard cabinet to give following modes of operation.

A	Position – I	12"O clock	OFF
B	Position – II	3"O clock	Plant „A" Only
C	Position – III	6"O clock	Plant „A" & „B"
D	Position – IV	9"O clock	Plant „B" Only

The alternator cannot be paralleled

Normally Feeder-I and II are fed through Plant A and Plant B based on the service experience, it is possible to supply feeder I and II from Plant A and B through operating the bus coupler contactor push button and the respective feeder contactor.

7.4.2 DC control Isolation switch

This rotary switch cuts off the dc supply to the control circuit in its OFF position. If the generator sets are not working thus switch should be kept in the OFF position.

Push Buttons and Switches provided on the Switch cabinet

S.no.	Name of push button/switch	Function
1	Engine ON	To start the engine
2	Rise	To increase the RPM of the Engine
3	Lower	To decrease the RPM of the Engine
4	Test switch TS-1	To test the condition of the Engine Failure indications
5	Test switch TS-2	To test the condition of the Alternator Failure indications
6	Test lamp switch	To test the condition of the Feeder Failure indications
7	Alarm isolation	To stop the alarm
8	Feeder ON	To switch ON the feeder
9	Engine STOP/RESET	To stop or reset the engine
10	Reset push button A OR B	To reset the fault conditions (alternator & feeder)
11	Feeder OFF	To switch off the feeder
12	Bus coupler ON	To switch ON the bus coupler

The engines are of two types –Cummins KTA19G5I and Greaves Cotton TBD41V12P engine. The Greaves Cotton Engine incorporates Electronic Instrumentation panel for starting the engine

7.5 STARTING THE DG SET WITH CUMMINS ENGINE

The starting sequence of the engine is as follows

7.5.1 Precautions

i) Before starting the engine, ensure that necessary quantity of lubricating oil , fuel oil, and cooling water have all been filled and the witches are in good condition

ii) Switch on the dc control switch which will light the DC On indication lamp

iii) Switch on the starter motor Isolation switch connects the DC supply from the starter battery to the starter motor circuit

iv) Press the test push button 1,2 & 3 to check the status of the fault indication lamps

- Press the engine start push button of any one engine selected for running
- First NC contact of the start push button opens the LOP circuit. It is positive interlock to ensure that the engine does not stop for the want of lube oil pressure build up at the moment of starting. Second NC contact opens the engine starting circuit of the other plant. This is an interlock to prevent the simultaneous starting of the other engine. Third NC contact de-energizes the BIC which disconnects starter battery charger from supplying to starter battery during starting.
- One of its NO contact energizes the FSRD (time delay relay for the starter solenoid) and FSS (Fuel start solenoid) and the other contact energizes SC (solenoid coil) of the starting motor for cranking the engine. When the engine attains full speed, the start push button maybe released.
- The instantaneous contacts of the FSRD maintain the supply for the FSRD and FSS. The NC contact of the start button and one of the delay contacts of FSRD keep the starter motor circuit open to prevent accidental restart by means of start push button. Another NC delay contact of FSRD keeps the LOP circuit closed. Once the engine starts, lube oil pressure developed opens the oil pressure switch ICLOP (internal combustion Engine Low Oil pressure) which keeps the LOP energized as long as there is sufficient pressure of Lube oil.

7.5.2 Adjustment Of Engine Speed

Watch the frequency meter. Adjust the speed by RISE or LOWER push button until the frequency meter reads 50 Hz. Here the speed of the engine is controlled by controlling the fuel flow into the engine by means of throttle motor. The RISE and LOWER push buttons control the direction of the throttle motor.

7.5.3 Plant Selection

Keep the plant selector switch as desired

7.5.3.1 PLANT A ONLY. This is done by switching on the ACB-A manually. If it is desired to feed both the feeders A and B from Plant A. Bus coupler contactor K2 can be energized by pressing the bus coupler push button. Paralleling of the alternators is prevented by the following mechanism

There are two NC contacts (one from each ACB), in parallel, in the bus coupler contactor circuit. When ACB-B is open, the bus coupler contactor circuit is closed through the NC contact of the ACB-B. suppose in this situation , ACB is manually closed. This will result in opening of the normally closed contact of the ACB-B, which in turn will cut off the supply to the bus coupler close coil, thereby resulting in opening of the bus coupler contactor.

7.5.3.2 PLANT B ONLY. This is done by switching the ACB-B manually. It is desired to feed both the feeders A and B from plant B , bus coupler ON push button. Paralleling of the alternators is prevented

7.5.3.3 PLANT A & B ONLY: Both the ACB‟s can be closed simultaneously but in this condition the bus coupler cannot be energized because the auxiliary contacts of the two ACB‟s in the bus coupler close coil circuit will be open. Hence the Plant A will feed only feeder A and Plant B will feed the feeder B

7.6 STARTING DG SET WITH GREAVES COTTON ENGINE

- Switch ON the DC Supply from DC ON switch
- Wait till the ready indication comes on EMS
- Confirm the working of the Fuel transfer Pump
- Press start Switch to start the Engine.
- Check the frequency and voltage on panel board after stabilising
- Check the working of Radiator Motor after Turning ON the ACB

7.7 FEEDER SELECTION

- Operate power supply On push button
- Set rotary switch DC-ISO-A to On position
- Lamp 'DC -ON' on the Panel-II
- Set rotary switch ' Plant selector switch' to Position -4.
- S2K9, S2K11 pulls in
- S2K8, S1K10 do not pull in
- Close manually the ACB
- Transformer-1 gets supply
- Switch on the radiator and exhaust fans in the engine room
- Press the push button SAETY LOOP
- Press the push button FEEDER B on
- Contactors S2K13 and S2K3 are energized
- Switch feeder B off
- After a moment push Feeder B ON
- Push bus coupler push button
- S2K11 and S2K2 pulls in

Same procedure can be adopted for the other feeder and plant

7.7.1 Safety Loop

The safety loop is the most important protective safety circuit. It guarantees the standard operation of generators and power supply. The generators must not work other than in ”stand alone” operation. A parallel operation is not possible because the generators are not designed for synchronous operation and the compensating currents can grow up to a dangerous size. Normally generator 1 supplies the bus bar 1 and the generator 2 supplies the bus bar-2

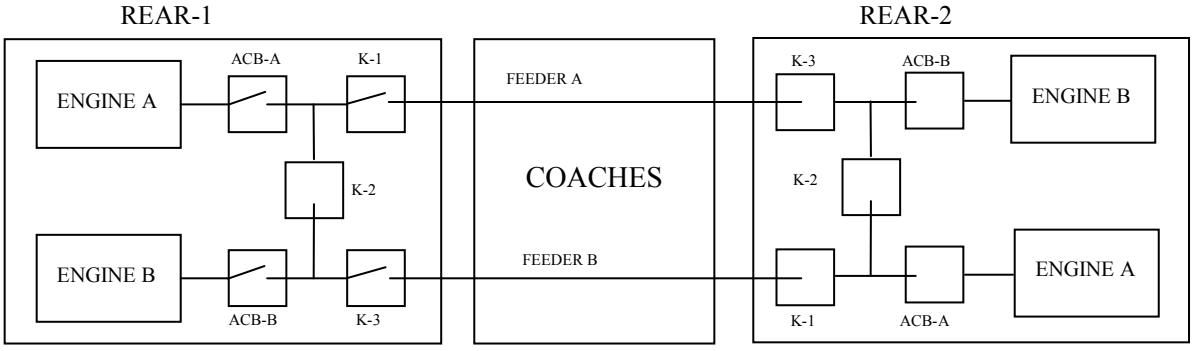
To achieve maximum flexibility it is possible to supply bus bar 2 via a coupling contactor from generator 1, or bus bar 1 from generator 2 , or both bus bars from one generator, respectively. The coupling can only be switched if one generator operates while the other is disconnected. Because the coupling is only allowed if the IV-coupler is voltage less, a protective circuit is required which before separating the couplers switches off the bus bar. For this purpose a safety loop is created by 2 control current contacts. A limit switch mounted on the receptacle terminal box is part of the safety loop. During coupling, after opening the mechanical locking, the limit switch is actuated causing an interruption of the control current circuit. Afterwards a power contactor is switched off and the main contacts become voltage less. To close the safety loop, the free plug of the last feeding line car has to be mated with the dummy receptacle where two bridged spring pressure contacts close the circuit

Relay used for safety loop instead of Darlington pair as used in conventional coaches

7.7.2 Interlock Preventing Accidental Paralleling Of Alternators In Rear Car With Alternator In Front Car

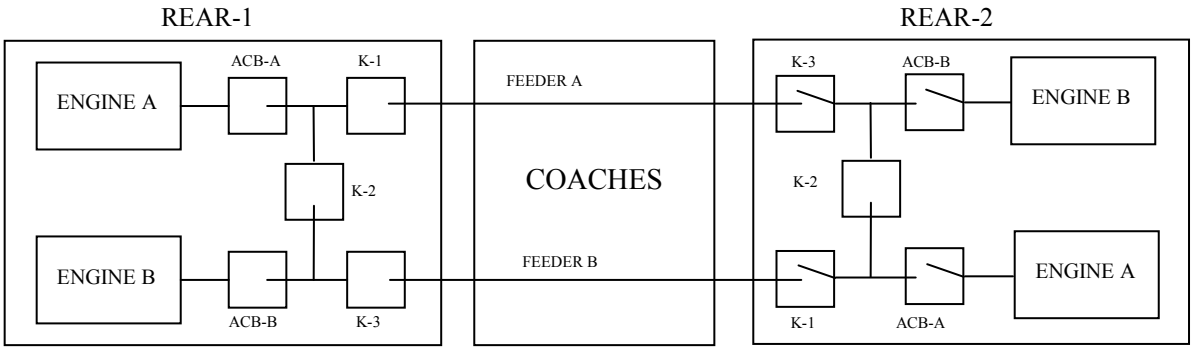
a) Standard external power car operation on rear 1

Each of the two alternators of the power car on rear-1 supplies one feeder. The alternators of the rear power car- 2 are switched off.



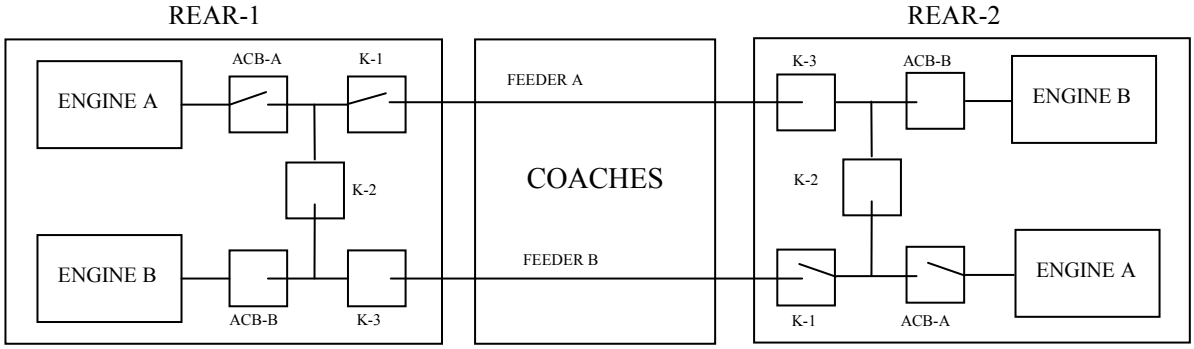
b) Standard external power car operation on rear 2

Each of the two alternators of the power car on rear 2 supplies one feeder. The alternators of the rear power car- 1 are switched off.



c) Standard external power car operation on rear 1 and 2

One of the two alternators of the power car on rear 1 and 2 supplies one feeder. Alternator-A on rear 1 supplies feeder A and alternator-A on rear 2 supplies feeder B.



7.8 PROTECTION SCHEME FOR RADIATORS & ROOF VENTILATORS

7.8.1 Two 60KVA 750/415 volts, star/star transformers are used to meet the load of the radiators and ventilation fan motors. HRC fuse protection both for the input and output side with a fuse of 63 amps, 1000 volts and 100 amps, 660 volts fuse respectively is provided.

7.8.2 Radiator motor is of 40 HP for the uprated DG set. This motors gets the supply through a star delta starter of 40 HP with a motor protection circuit breaker provided in the starter itself. The rating of the MPCB is 63 amps, 660 volts of Sprecher and SHUH make or equivalent SIEMENS make

7.8.3 Wago connectors are used for further connections to the cables

7.9 EARTHING CONCEPT

Based on the IS:3043, the system of earthing in LHB Power Car is as follows:

Neutral of the generator car is earthed through a neutral reactor i.e. exposed conductive parts are connected to electrically independent earth electrodes.

The generators' neutral point is earthed thus creating a TN-net continuing to coupling receptacles and transformers. Switch cabinet S2 contains a central PEN-bar to which the earth of generators and bus bars are connected.

The 60 kVA transformer operates as isolating transformer. The secondary neutral point is not earthed, thus an IT-net exists. The working stock bodies are separately or commonly connected with an earthed protective wire.

No active IT-net conductor is directly earthed so that in case of insulation failure only a low fault current caused by the capacitances of the cables to earth can flow. The fuse is not triggered so that the power supply is maintained even in case of single line-to-earth fault. This means that the reliability of this kind of networks is higher than in other networks. In case of a second fault one of the two faulty devices will be switched off before the permissible contact voltage of 50 V is reached.

The double-pole 110V DC mains is equally unearthed which means for the consumers that they are double-pole protected.

Keys on the switch cabinet door and the voltmeter permit to measure the voltage between positive and negative potential of DC mains and earth. In such a way the mains insulation condition can be checked.

For monitoring the AC mains insulation protective devices are used, their function is described later.

Accordingly in the Generator-cum-brake van earthing points are provided:
- To be earthed in the underframe:
  - Battery Box
  - Battery fuse boxes (positive and negative)
  - Transformer container
  - Tank for fresh water
  - Brake PCB
  - Diesel tank

7.10 SMOKE DETECTOR

Smoke detectors are provided in the power car to detect any smoke generated due to any precarious condition arising during the working of the power cars

- A two channel control unit with visual indicators for level of smoke, a built in piezo buzzer and an external socket for connection of the hooters is provided.
- Two smoke detector units – one unit is located in the power panel area directly above it and the other unit is placed inside the engine room. These detectors are connected to the unit by four core shielded cable.
- Two hooters are located inside the engine room and the power-panel area for annunciation
- The system works on 110 volts dc through 110 v dc from the coach battery provided in the LHB coaches.
- The detectors detect the smoke emitted either due to short circuit / overheating of the electrical cables or due to other reasons. Insulating material like PVC or polymer release smoke due to overheating of persistent nature.

7.11 RELAY FOR PROTECTION OF GENERATOR CAR

Different relays provided for protection of generator car and their settings are as follows:

SN	Description	Nos. Fitted	Setting	Range	Operation Time (Sec.)	Relay Type
1	**POWER GENERATION CIRCUIT**					
i)	Alternator Earth Leakage Relay (A)	2	2.5	1-4	0.5	Electro magnetic
ii)	Feeder Earth Leakage Relay (A)	2	3	2-8	0.5	Electro magnetic
iii)	Under Voltage Relay (V)	2	375	375-415	8	Electro magnetic
iv)	Feeder Over Load Relay (A)	2	300	80-300	30	Bi-metallic thermal over load
v)	Air Circuit Breaker (A)	2	360	800	0.5	Open execution
vi)	Over Speed Relay (RPM)	2	1800	0-2500	< 1	-
vii)	High Water Temperature (ºC) INTAC	2	107	107	-	Temp. Switch
viii)	High Water Temperature (ºC) CUMMINS	2	97	40-105	-	Temp. Switch
ix)	Low Lub Oil Pressure Switch (Kg/Cm^2)	2	1.8*	0-7	-	Pressure Switch
2	**AC PLANT CIRCUIT**					
i)	Compressor Motor Over Load (A)	1	10	8.9-13.5	40	Bi-metallic thermal over load
ii)	Condenser Motor Over Load (A)	2	2.4	2.4-3.8	34	Bi-metallic thermal over load
iii)	Blower Motor Over Load (A)	1	1.5	1.58-2.5	24	Bi-metallic thermal over load
iv)	LP Cut Out (PSI)	1	10	7-85	0.5	Pressure Switch
v)	HP Cut Out (PSI)	1	225	85-425	0.5	Pressure Switch

* for Greaves Engines, for others refer OEM's manual.

7.12 COMPARISON OF POWER CAR PROVIDED WITH UPRATED DIESEL ENGINE AND CONVENTIONAL POWER CAR

The conventional power cars of M/s Cummins make was insufficient to drive the 500 kVA alternator; some of the changes have been made and provided with up-rated diesel engine. The comparison is as follows:

SN	Description	Conventional power car	LHB/ Garib Rath power car
1	Engine	KTA-1150	KTA19-G5I
2	Capacity	450 BHP	490 BHP
3	Electrical Power available	336 KW	420 KVA at 0.8 pf
4	Radiator motor	20 HP	40 HP

Uprated engine supplied by M/s Cummins India Ltd., Kothrud, Pune complies with the emission norms as laid down by the Automotive Research Association of India.

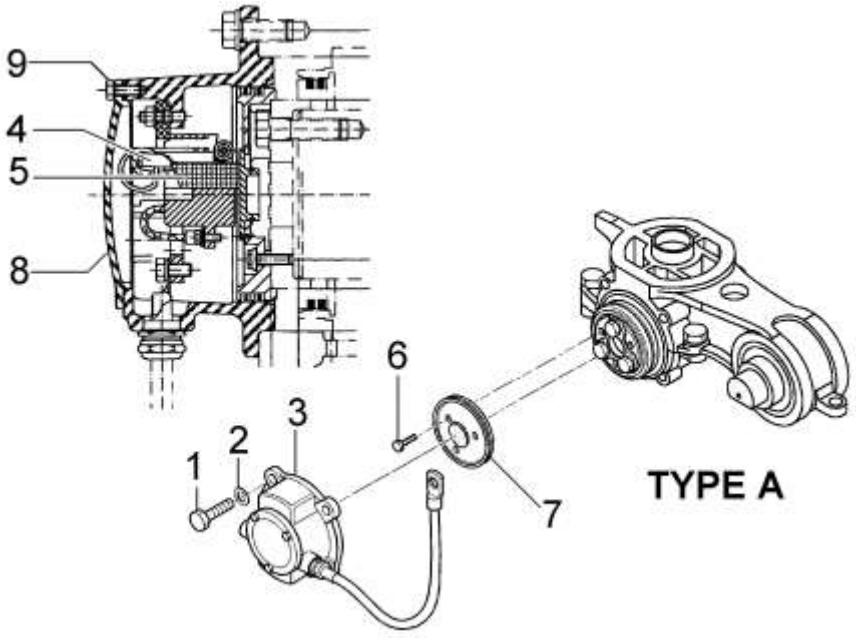
7.13 MISCELLANOUS PROTECTIONS

7.13.1 Use of flexible polyamide Conduits and End Fittings with its accessories

Specially flexible polyamide (PA6 / PA12) conduits for cold impact have been used in the present powers cars both LHB and Garib Rath Power cars. These conduits have excellent properties of very high impact strength at low temperature, is free from halogens and cadmium, chemically resistant to fuels, mineral oils, alkalies, weak acids etc. These are suitable for a wide temperature range of -50 °C to +105 °C. The end fittings used are also of the same material and are suitable for protection class IP67 and IEC 60529. These end fittings are available in different angled form i.e. straight, 45° angle, 90°angle to suit the site conditions. Presently conduits is being procured as per RDSO"s specification no. RDSO/PE/SPEC/AC/0138-2009(Rev-1) with the RDSO"s approved sources.

7.13.2 Use of Wheel Set Earthing Device

This equipment is provided to bypass the fault current from the bearings and not to allow the current to pass through the bearings whch may become defective and effect the life of the bearings



7.13.3 High Neutral Current (In BHEL/KEL & Kirloskar Alternator only)

LHB coaches are provided with power transformer of star -star connection. The generator neutral is connected to star point of the generator. Due to star -star connection 3rd Harmonics are generated and triple frequency which is normally three times the normal current flowing through the neutral conductor. To overcome the problem one reactor is provided in between the generator neutral and the local neutral, which restricts the 3rd harmonic component to go back to the generator.

As per latest RDSO specification, harmonics should not be more than 5%.

7.13.4 Insulation Monitoring Device

Insulation Monitoring Device is provided in the LHB Power car, which gives indication in case the insulation of the system is less than the preset value of the device.

Insulation measuring device monitors the insulation resistance of unearthed AC and 3 phase mains (IT-NETs). A measuring DC voltage is created in the device. The positive pole of measuring device is applied to the mains which is to be monitored and the negative pole is applied to earth through an electronic measuring circuits. These terminals are permanently monitored and in case of failure (when ohmic insulation between mains and earth falls below the set value and closes the measuring circuits) a signal LED flashes and a luminous display on the switch cabinet door is activated.

7.13.5 External Local Supply

External Local supply at 415V, 3Ph shall be provided through the sockets provided in the coach. The interlocking of external supply with D.A. set supply shall be provided as per design of imported LHB coaches. A 5-pole plug and socket of 125A rating with pilot contact shall be provided for external supply. The necessary protective mechanism will be provided to prevent short-circuiting of two supplies and danger to the operating/maintenance staff which may be similar to imported LHB coaches.

7.13.6 Use of E-Beam Irradiated Cables

All the coach wiring for the power cars have been provided with e-beam cables which are highly flame retardant, Low Smoke, Low Toxic, Zero Halogen Emission, Better Thermal Properties), High Current Ratings - Operating Temperature up to 230°C, Special Polymers to cover Wide Temperature range from -65°C to +230°C, no Risk of Deformation above Short Circuit Temperatures, Rugged **Mechanical Properties** – Superior Abrasion/Scrapes & Cut-through Resistance, Resistant to Ultra-Violet (UV) Rays & Impermeable to Moisture.

7.14 COMPARATIVE SAFETY AND PROTECTIONS OF THE LHB AND GARIB RATH POWER CAR

	DG SET	**LHB**	**GARIB RATH**
1.	ENGINE	490 BHP	490 BHP
2.	Alternator	500 KVA	500 KVA
3.	DG set control panel protections		
4.	Overload	As per Engine details	As per engine details
5.	Under voltage	Novago make under-voltage relay has been provided	
6.	Earth leakage	Novago make relay with CT	
7.	Short circuit	ACB to cat no CNCS800	
	Main Feeder control		
8.	Overload	By digital relay of MICOM make	By means of CT operated bi-metallic relay of BCH make
9.	Earth Fault relay	Insulation monitoring relay of Bender make	ACBT type earth fault relay of novago make
10.	Feeder contactors	Vacuum contactors 3TF68 of M/s Siemens make	
11.	Fire extinguishers	Water foam based in OEM LHB	Dry powder type hydrants provided
12.	Radiators		
	Supply	Star delta starter	
	Protection	MPCB of 63 amps provided	
13.	Exhaust fans		
14.	Supply	Star delta starter	
15.	Protection	MPCB provided	
	COACH DISTRIBUTION PANEL		
16.	Panel	Integrated modular design panel for controlling the ac panel and other switchgear	Separate power and ac control panel for the crew room AC and the guard room AC
17.	Disconnecting and earthing device	Provided	Not provided
18.	Control voltage	110 v dc	415 v ac

	DG SET	**LHB**	**GARIB RATH**
19.	Protection	Measuring and monitoring relay for u/v, o/v, single phasing etc	Not provided
20.	Incoming fuses 750 volts side	3 x 63 A HRC fuses	Incoming feeder directly on the contactors
21.	Incoming fuses 415 volts side	3 x 100 A HRC	3 x 100 A HRC
	RMPU motor protection	MCB + thermal switches inside the motors	MCB + overload relays
22.	Pumps	Micro-controller based pump equipment	
	Transformers		
23.	For radiator –1	60 KVA Y-Y	60 KVA Δ-Y
24.	For radiator –2	60 KVA Y-Y	60 KVA Δ-Y
25.	For coach load	60 KVA Y-Y	50/3 KVA Δ-Y
	AIR CONDITIONING		
26.	Capacity	1 x 7t	1 x 5t 1 x 1.5 t (guard)
27.	Control	Microprocessor based	Conventional control
28.	Thermostat	NTC type	Electronic
29.	Fresh air	Motorized Damper control	Manual

7.15 BASIC FEATURES OF THE LHB POWER CAR AND GARIB RATH POWER CAR

SNo	Particulars	LHB	Garib Rath
1	Coach length	23.5 meters	21.3 meters
2	Speed potential	160 Kmph	130 Kmph
3	Roof mounted ac unit	1 x 7 ton	1 x 5 ton 1 x 1.5 ton
4	No of transformers	3 x 60 KVA Y-Y	2 x 60 KVA ▲-Y 1 x 50/3 KVA
5	Pumps	One set of two pumps	One set of two pumps
6	Pump controller	Provided	Provided
7	Water storage tank	1 x 685 litre	
8	Engine	2 x 490 BHP	2 x 490 BHP
9	Alternator	2 x 500 KVA	2 x 500 KVA
10	Radiator fan	2 x 40 HP	2 x 40 HP
11	Ventilator fan motor	2 x 5 Kw	2 x 5 Kw
12	Starter battery	1 x 290 Ah, 24 V	1 x 290 Ah, 24 V
13	Smoke detector	Provided	Provided
14	Temperature control	Fine control in 7 steps	Coarse in 3 steps
15	Humidity control	Provided	Not provided
16	Window size	Bigger	Smaller
17	Anti skid device	Provided	Not provided
18	Braking	Disc braking	Conventional disc braking
19	IGBT based battery charger	Fitted	Conventional battery charger provided
20	Battery	70 Ah for dc control of power panel	120 Ah for emergency light
21	Disconnecting and earthing device	Fitted	Not provided
22	Transformer fuses	Provided inside the power panel	Provided on the transformer itself
23	Insulation and monitoring device	Fitted	Not fitted
24	Self diagnosing system	Fitted	Not fitted
25	Flap motor to adjust the air inflow	Fitted	Not fitted
26	Thermostat	NTC type	Electronic
27	Suction and discharge pressure indicated on the panel	Provided on the panel board	Not provided

7.16 MAINTENANCE SCHEDULES

PERIODICITY

D1 = TRIP INSPECTION

D2 = 03 MONTHS

D3 = 06 MONTHS

7.16.1 Alternator

SN	Activity	TI (D1)	3M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
1.	Check and ensure proper condition and tightness of mounting bolts	✓	✓	--	--	✓
2.	Check and ensure proper Tightness of all connections of alternator outgoing & control cables	--	✓	✓	--	✓
3.	Check and ensure proper earthing connection	--	✓	--	--	✓
4.	Check and ensure proper Condition of coupling nut bolts and their tightness. Attend them, if required	✓	✓	--	--	✓
5.	Check alternator for any unusual sound and attend same	✓	✓	--	--	✓
6.	Check and ensure generation of proper voltage (750V, 50Hz)	✓	✓	--	--	✓
7.	Ensure proper Cleaning and tightness of connection of Excitation System. Use thermal imaginer equipment to check temperature of cable nuts, connecting nut bolts etc. on load	--	✓	--	✓	✓
8.	Ensure proper Greasing of Bearings	--	--	--	--	✓*
9.	Ensure proper Servicing and Overhauling by disassembly of Coupling, End covers, Rotor ,Stator and Excitation system etc and thorough cleaning of all parts including various windings by blower and thinner and application of anti track varnish on exposed portion of windings. Ensuring proper cleaning and Greasing of Bearings and their replacement, if required. Replace rubber bushes of alternator and diesel engine coupling. ensure alignment of alternator and diesel engine coupling with dial gauge during fitment after servicing and overhauling.	--	--	--	--	✓

*** greasing of bearing shall be as per recommendation of OEMs.**

7.16.2 Side Body Filter

SN	Activity	TI (D1)	3M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
1.	Check and ensure proper condition of mounting and fitment of side body filters	✓	--	--	--	✓
2.	Remove and ensure proper cleaning of side body filters by dry compressed air at a pressure **1.75 kg/cm^2** (**25psi**) with help of portable compressor	--	✓	--	--	--
3.	Ensure proper cleaning of sidewalls and ceiling of engine room	--	✓	--	--	✓
4.	Replace old side body filters with new	--	--	--	✓	✓

7.16.3 Starting Battery

SN	Activity	TI (D1)	3M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
1.	Check and ensure proper condition of mounting of batteries on frame	✓	--	--	--	--
2.	Check and ensure proper condition of connection cables, terminal connection tightness and application of petroleum jelly on it	✓	--	--	--	--
3.	Check and ensure proper condition of Air Vents of batteries	✓	--	--	--	--
4.	Check and ensure proper Specific Gravity (SPG) of batteries and it‟s electrolyte level. Top up with distill water, if required	✓	--	--	--	--
5.	Check and ensure proper battery voltage	✓	--	--	--	--
6.	Replace old starting batteries with new	--	--	--	--	✓

7.16.4 Battery Charger

SN	Activity	TI (D1)	3M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
1.	Check and ensure proper condition of mounting bolts and covers	✓	--	--	--	✓
2.	Check and ensure proper tightness of connections	✓	--	--	--	✓
3.	Ensure proper cleaning by dry compressed air at a pressure **1.75 kg/cm^2** (**25psi**) with help of portable compressor	--	✓	--	--	--

SN	Activity	TI (D1)	3M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
4.	Check and ensure proper condition of electrical wires and attend them as and when required	✓	✓	--	--	✓
5.	Check operation of battery change over switch and replace if required.	✓	--	--	--	✓
6.	Check and ensure proper operation of battery charger.	✓	--	--	--	✓
7.	Ensure proper Servicing and Overhauling by opening the covers and thorough cleaning of all parts by blower and thinner. Replace the Voltmeter and Ampere meter with new calibrated meters	--	--	--	--	✓

7.16.5 Self Starter Motor

SN	Activity	TI (D1)	3M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
1.	Check and ensure proper condition of mounting	✓	--	--	--	✓
2.	Ensure its proper working. Replace starter motor, relay, switch gears, cables, terminals etc., if found defective,	✓	--	--	--	--
3.	Check and ensure proper cleaning by blower/ vacuum pump and replace the carbon brush, if required	--	--	✓	--	--
4.	Check and ensure proper condition of electrical wires and attend them as and when required on condition basis.	✓	--	--	--	✓
5.	Ensure proper Servicing and Overhauling by disassembly of Coupling, End covers, Rotor ,Stator etc and thorough cleaning of all parts including various windings by blower and thinner and application of anti track varnish on exposed portion of windings. Ensuring proper cleaning of bearings/ bush and their greasing and replacement, if required. Ensure Replacement of Carbon Brushes	--	--	--	--	✓

7.16.6 Power Panel /Control Panel

SN	Activity	TI (D1)	3M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
1.	Check and ensure proper condition of mounting bolts /anti vibration pads etc	--	✓	--	--	✓
2.	Check and ensure proper condition of electrical wires/cables /connections and attend/ tighten/ replace them, if required	--	✓	--	--	✓
3.	Check and ensure proper cleaning of Power Panel, Control Panel by Vacuum Pump and dry compressed air at a pressure **1.75 kg/cm^2** (**25psi**) with help of portable compressor	--	✓	--	--	✓
4.	Check and ensure proper working of indication lamps ,Push Buttons, Switches and Fuses and Replace them , if required	✓	--	--	--	✓
5.	Check and ensure proper closing of main breaker (ACB) contactor and Attend/Replace, if required	--	--	✓	--	✓
6.	Check and ensure proper working of instruments provided on instrument panel	✓	--	--	--	✓
7.	Check and ensure proper working of DC control & Panel Wiring System and attend, if required	--	✓	--	--	✓
8.	Check and ensure proper working of different measuring meters- Ammeter, Volt meter, kW meter, frequency meter, R.P.M. meter and replace, if required	✓	--	--	--	✓
9.	Checking of the working of Contactors (C1,C2,C3,C4), Feeder Contactors and bus coupler contactors.	✓	--	--	--	✓
10.	Ensure Cleaning and tightness of connections of Power Panel/Control Panel. Use thermal imaginer equipment to check temperature of cable lugs, connecting nut bolt, contactors etc. on load	--	✓	--	--	✓
11.	Ensure Thermo Imaging of Power Panel on Load	--	✓	--	--	✓
12.	Ensure tightness of Bus Bars	--	✓	--	--	✓
13.	Strip Contactors, Bus Bars, MCBs, Air Circuit Breakers and all type of rotary switches etc. and do thorough cleaning of Panel and its equipments by blower/ Vacuum Pump and thinner and Ensure their proper Servicing and Overhauling. Replace contacts of Contactors, if required Ensure Thermo Imaging of Power Panel on Load after Servicing and Overhauling	--	--	--	--	✓

7.16.7 Radiator, Radiator Pipeline and Radiator Chamber

SN	Activity	TI (D1)	3M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
1.	Check and ensure proper condition of mounting bolts and anti vibration pads etc	--	✓	--	--	✓
2.	Check and ensure proper cleaning of radiators. Clean by water jet machine **4.9-5.6 kg/cm^2** (**70-80 psi**) with **OGR** and **ID-27** or any other suitable cleaning agent	--	✓	--	--	--
3.	Check Radiator water level and top up with distilled water, if required.	✓	--	--	--	--
4.	Check filling cap and condition of radiator fan bolts for tightness and attend, if required	✓	--	--	--	--
5.	Check condition of radiator pipeline, clamp & water leakage and attend, if required	✓	--	--	--	--
6.	Check condition of radiator chamber, doors, hinges, latches etc. and attend the same to ensure proper condition.	✓	--	--	--	✓
7.	ensure proper doors, latches, ceiling and intactness of baffles etc. for radiator chamber	✓	--	--	--	✓
8.	Strip and ensure thorough cleaning by water jet machine **4.9-5.6 kg/cm^2** (**70-80 psi**) with **OGR** and **ID-27** or any other suitable cleaning agent. Remove internal scaling if any, with the help of suitable descaling agent.	--	--	--	--	✓
9.	Replacement of „O" Ring of radiator pipe line	--	--	--	--	✓
10.	Fill up the radiator with distilled water, proper coolant and descaler	--	--	--	--	✓

7.16.8 Radiator Motor and Starter

SN	Activity	TI (D1)	3M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
1.	Check and ensure proper condition of mounting bolts	✓	--	--	--	✓
2.	Check and ensure proper condition of electrical cables/wires and attend them as and when required on condition basis	✓	--	--	--	✓
3.	Ensure Cleaning and checking of connection tightness of starters of radiator motors. Use thermal imaginer equipment to check temperature of cable lugs, connecting nut bolts etc. on load to find out loose connection. Check IR.	--	✓	--	--	✓

SN	Activity	TI (D1)	3M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
4.	Ensure Checking of condition of Radiator Motor, connection and its tightness	✓	--	--	--	✓
5.	Ensure Checking of condition of Radiator Motor Fans and its tightness and attend the defects. Replace motor in sick line/ workshop, if found defective.	✓	--	--	--	✓
6.	Ensure greasing of radiator motor.	--	--	--	--	✓
7.	Check and ensure proper working of Starter of Radiator motor and Replace defective contactor/overload relay if required	✓	--	--	--	✓
8.	Strip and overhaul radiator motor including ensuring proper condition/ working of its bearings	--	--	--	--	✓
9.	Strip and overhaul starters of radiator motor	--	--	--	--	✓

7.16.9 Roof Exhaust Fans and Motors

SN	Activity	TI (D1)	3M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
1.	Check and ensure proper condition of mounting bolts	✓	--	--	--	✓
2.	Check and ensure proper condition of electrical cables/wires and attend them as and when required on condition basis	✓	--	--	--	✓
3.	Ensure Cleaning and checking of connection tightness of starters of Roof Exhaust motors. Use thermal imaginer equipment to check temperature of cable lugs, connecting nut bolts etc. on load to find out loose connection.	--	--	✓	--	✓
4.	Ensure Checking of condition of Roof Exhaust Motor, connection and its tightness	--	--	✓	--	✓
5.	Ensure Checking of condition of Roof Exhaust Motor Fans and its tightness and attend the defects. Replace motor in sick line/ workshop, if found defective.	✓	--	--	--	✓
6.	Check and ensure proper working of Starter of Roof Exhaust motor and Replace defective contactor/overload relay if required	✓	--	--	--	✓
7.	Check IR value of Vent Motors.	--	--	--	--	✓

SN	Activity	TI (D1)	3M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
8.	Strip and overhaul Roof Exhaust motor including ensuring proper condition/ working of its bearings.	--	--	--	--	✓
9.	Strip and overhaul starters of Roof Exhaust motors.	--	--	--	--	✓
10.	Replace bearings of motors and self starters.	--	--	--	--	✓

7.16.10 Cables and Trenches

SN	Activity	TI (D1)	3M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
1.	Check and ensure proper condition/ securing of fixing bolts and covers of all trenches	--	✓	--	--	✓
2.	Check and ensure proper cleaning of all trenches by Brush, Jute/cotton waste etc	--	--	*✓	--	✓
3.	Check and ensure proper condition of cables and attend/replace them, if required	--	--	*✓	--	✓
4.	Ensure proper securing of cables against any rubbing, sharp edges	--	--	*✓	--	✓

*** Alternate**

7.16.11 Fuel Tank

SN	Activity	TI (D1)	3M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
1.	Check and ensure proper condition of all mounting nuts/ bolts and mounting brackets/clamps etc	✓	--	--	--	✓
2.	Ensure proper Cleaning of fuel tank externally	✓	--	--	--	--
3.	Drain the fuel and clean the tank internally as well as externally including the pipe line and Sediment Junction Box etc.	--	--	--	--	✓
4.	Check Condition of diesel filling cap and Fuel Gauge/ diesel leakage and attend, if required	✓	--	--	--	✓
5.	Replace wheel valves of fuel pipe line	--	--	--	--	✓
6.	Ensure Opening and servicing of fuel gauges and replacement of rubber items	--	--	--	--	✓
7.	Ensure replacement of fuel gauges.	--	--	--	--	✓*

*** Alternate**

7.16.12 Safety System

S.No.	Safety System	Circuit Checking	Calibration/ Replacement
1.	AEL (alternator earth leakage relay)	D1	SS2
2.	FEL (feeder earth leakage relay)	D1	SS2
3.	FOL (feeder overload relay)	D1	SS2
4.	OVR (over voltage relay)	D1	SS2
5.	UVR (under voltage relay)	D1	SS2
6.	HWT (high water temperature)	D1	SS2
7.	LLOP (low lube oil pressure)	D1	SS2
8.	OSR (over speed relay)	D1	SS2
9.	LWL (low water level)	D1	SS2

7.17 MAINTENANCE SCHEDULES OF DIESEL ENGINES FOR CUMMINS MAKE

Cummins Diesel Engine Maintenance Activities Periodicity is as follows:

S.No.	Activities	Periodicity	
1.	A check	Every trip	D1
2.	B check	03 Months (OEM recommendation 300 Hrs / 3 months)	D2
3.	C check	Annual (OEM recommendation 1500 hrs/ 1year)	Alternate D3
4.	D check	POH/36 months (OEM recommendation 6000 hrs/ 2 years)	SS-2
5.	E check (overhauling of engine)	On condition basis	

7.17.1 A Check /Trip Schedule (D1)

i) Check all Engine safeties for their proper functioning. Replace, if found defective

ii) Check condition of coupling nut bolts and their tightness. Attend them, if required

iii) Check vacuum indicator and clean air cleaner element at 4.22 kg/cm2 (60 PSI) air pressure, Check air restriction and ensure that it does not exceed 635 mm (25") of water column

iv) Check lube oil level and condition of lube oil. See reason of less oil and top up/refill, if required

v) Check governor oil level. Top up/refill, if required

vi) Check leakage of fuel, lubricating oil and coolant. Attend, if required

vii) Check all hoses, pipes for any leakage. Arrest all leakages immediately to make Generator Car free from oil & water tracing

viii) Check and ensure proper condition of safety nut bolts of fuel tank.

ix) Check and clean engine & its oil tray to make it free from any oil traces & dust

x) Drain water from fuel water separator through drain valve

xi) Check and ensure proper condition of mounting bolts and various vibration dampers/ anti vibration pads etc.

xii) Check and ensure proper cleaning of floor, wall etc in engine room

7.17.2 B Check/ 3 Monthly Schedule (D2)

Carry out B- Check after 300 running hrs/ 03 months for M/s Cummins make Diesel Engine which shall include **all works** mentioned above in **A check schedule** that must be carried out in addition to carrying out following additional works during B- check of diesel engine:

a) Air system

i) Check condition of element for chocking/ torn sealing and attend same,

ii) Check and ensure proper condition of Pre-Cleaner,

iii) Check and change Air cleaner element if required,

iv) Check and ensure proper condition of air hose,

v) Check and clean breather and

vi) Inspect exhaust line and rectify leakage, if any.

b) Fuel system

i) Change fuel filter,

ii) Check hose condition: fuel supply & drain line,

iii) Check & clean the tank and Non Return Valve and attend the same, if required

iv) Inspect fuel system and attend same, if required.

c) Lubricating system:

i) Change lube oil filters,

ii) Change lube oil,

iii) Change super by pass filters,

iv) Check Lube Oil Pressure (LOP) Gauge,

v) Check Lube Oil Temperature (LOT) Gauge,

vi) Check the filter for any metal particles due to wear and tear of any part inside engine,

vii) Change Governor oil

d) Cooling System:

i) Check and ensure proper coolant Ph value,

ii) Check and ensure proper coolant concentration,

iii) Check and ensure proper Cleaning of Breather,

iv) Check and ensure proper Water Temp. Gauge and

v) Check and ensure proper Radiator inlet & out let water temperature difference. If, found less, then radiator should be cleaned with **OGR** & **ID-27**.

7.17.3 C-Check/Annual Schedule (Alternate D3)

Carry out C-check after 1500 running hrs/Annually for M/s Cummins which shall include all works mentioned above in **A check schedule and B check schedule** that must be carried out in addition to carrying out following additional works:

i) Replacement of air filter (inner & outer).

ii) Replacement of tappet cover gasket.

iii) Proper tappet setting.

iv) Check and ensure proper condition of Alternator terminal connection.

v) Clean trench by compressed air without disturbing cable dressing.

vi) Check and ensure proper condition of accessories drive, Turbo charger and crankshaft end play.

vii) Check and ensure proper Greasing of Alternator.

viii) Take blow by on full load as per manufacturer‟s guidelines.

ix) Check and ensure proper setting of injector.

x) Check and ensure proper cleaning of turbo charger‟s compressor wheel & diffuser.

xi) Carry out **BORESCOPIC** inspection to check condition of cylinder components.

7.17.4 D-Check/POH schedule (SS-2)

D check will include the following in addition to C check schedule:

i) Servicing & calibration of Fuel pump along with replacement of requisite parts

ii) Servicing & calibration of Turbocharger along with replacement of requisite parts

iii) Servicing & calibration of Injector assembly along with replacement of requisite parts

iv) Servicing & calibration of Water pump along with replacement of requisite parts

v) Replacement of vacuum indicator

vi) Replacement of all filters and rubber hoses and clamps of air line, fuel line and water line

vii) Replacement of HWT, LLOP, LWL

viii) Remove the heat insulation from Exhaust Pipelines and Manifold and replace with new after checking of leakage in exhaust system

ix) Check condition of complete exhaust system and pipeline and ensure there is no leakage. Replace the part found leaky.

x) Checking and ensuring that all nut bolts should be tightened as per specified torque by OEMs

7.17.5 E – Check (on condition basis)

E check will include the following in addition to D check schedule:

i) Servicing & calibration of Cylinder Head along with replacement of requisite parts
ii) Servicing & calibration of Hydraulic Governor along with replacement of requisite parts
iii) Servicing & calibration of Connecting Rod along with replacement of requisite parts
iv) Replacement of silencer
v) Replace exhaust flexible pipe and ensure no leakage in exhaust line
vi) Replacement of AVM pads for DG set.
vii) Check and ensure that all nut bolts should be tightened as per as per specified torque by OEMs

The above is as per OEM recommendation and may be suitably changed if the OEM issues any change. The recommendation of the OEM shall be final.

7.18 MAINTENANCE SCHEDULES OF DIESEL ENGINES FOR GREAVES MAKE (TBD41V12)

Greaves Diesel Engine Maintenance Activities Periodicity is as follows:

S.No.	Checks	Periodicity
1.	A	**Daily**
2.	M1	Every 500 Hrs/ 6 Months
3.	M2	Every 1500 Hrs/ 1 Year
4.	M3	Every 4500 Hrs/ 18 months
5.	M4	Every 6000 Hrs/ 2 Years
6.	M5	Every 12000 hrs

Sr. No.	Engine System	Check/ Clean/ Change/ Calibrate	Description	A	M1	M2	M3	M4	M5
1.	Lube oil System	Check	Oil leaks	✓					
2.			Oil Pressure & Temperature gauges	✓					
3.			Existing Oil Filter for metal particles due to wear & tear of the internal Engine parts		✓				
4.			Lube Oil Level In Sump	✓					
5.		Change	Centrifugal Filter Paper Element		✓				
6.			Lube oil Spin on Filter (As required)		✓				
7.			Front & Rear Oil seals						✓
8.			Lube Oil		✓				
9.	Fuel System	Check	Fuel Leaks	✓					
10.			Fuel Level In Tank	✓					

Sr. No.	Engine System	Check/ Clean/ Change/ Calibrate	Description	A	M1	M2	M3	M4	M5
11.			Actuator Linkage (Link Rod Ball Joint)			✓			
12.		Drain	Drain sediments form Water separator	✓					
13.		Clean	Clean Water separator (As Required)		✓				
14.			Injector Nozzles & Spray If Necessary (Only perform if black smoke /Not taking load related problem persists)			✓			
15.			Fuel Tank				✓		
16.		Change	Fuel Filter Cartridge (As required)		✓				
17.			Vertical FTP Carbon Brush		✓				
18.			High Pressure fuel Pipes					✓	
19.			Mico Bosch Coarse fuel filter (As required)		✓				
20.		Calibrate	Calibrating the Fuel Pump						✓
21.	Cooling system	Check	Coolant Leaks	✓					
22.			Coolant Level in Radiator	✓					
23.			Radiator Motor , Fan , Hub & Bearing Assembly				✓		
24.			Coolant Level & Temperature Gauges	✓					
25.			Check Belt Tension	✓					
26.		Clean	Radiator Fins			✓			
27.		Check & Top Up	Add Coolant Additive		✓				
28.		Check & Change	Main Water Pump if required					✓	
29.			Secondary Water Pump If Required					✓	
30.		Change	Radiator Cap & Rubber Ring				✓		
31.			Coolant Water & Additive				✓		
32.			COOLANT CIRCUIT HOSES					✓	
33.			FLEX MASTER COUPLINGS - O RINGS					✓	
34.			Water Pump Belt (As required)				✓		
35.	Air system	Check	Air Leaks	✓					
36.			Air Cleaner Restriction (Vacuum Indicator)	✓					
37.			Turbo Charger -Axial & Radial Play (0.2 mm)				✓		

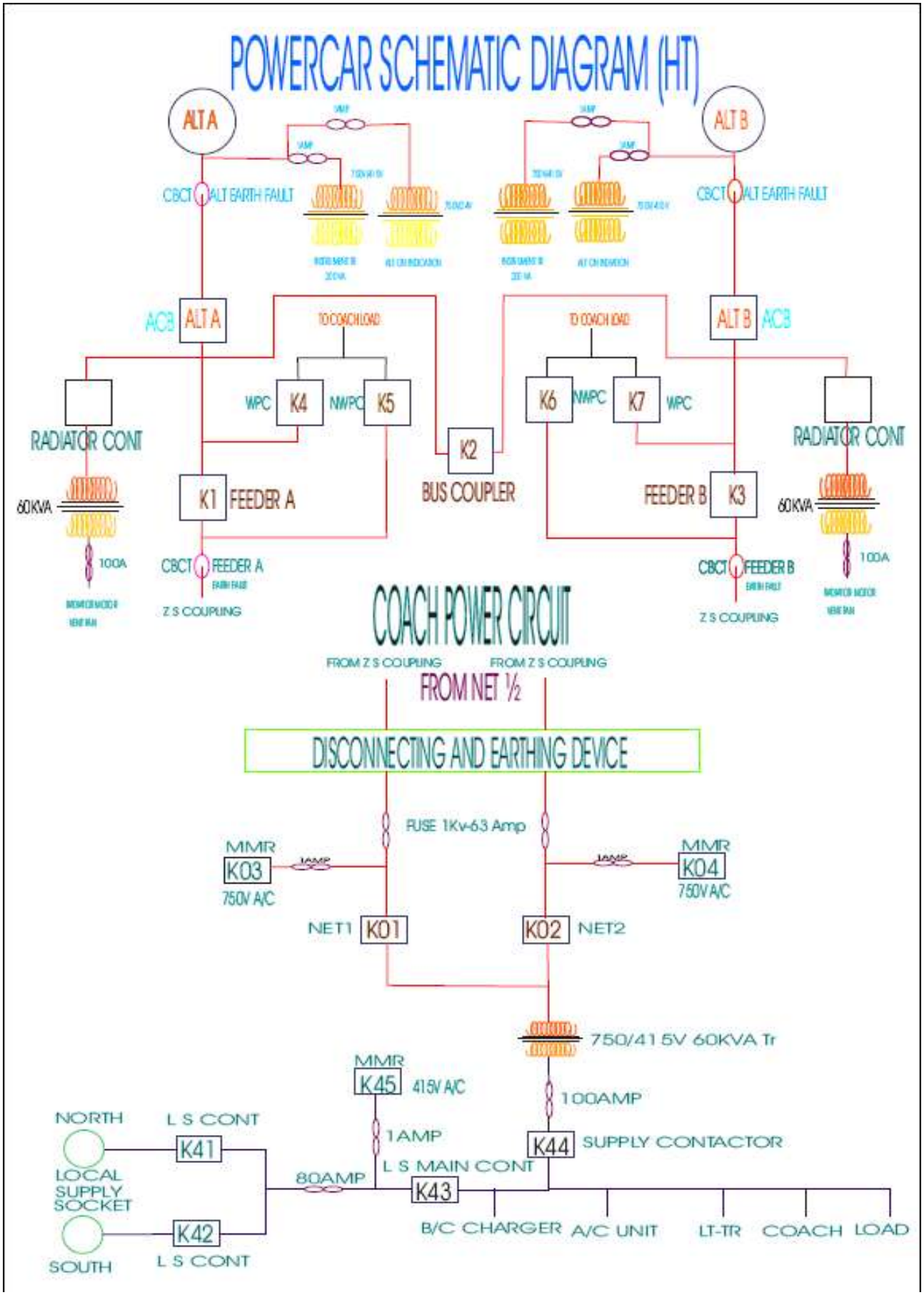
Sr. No.	Engine System	Check/ Clean/ Change/ Calibrate	Description	A	M1	M2	M3	M4	M5
38.		Check & Change	Air Filter Element (Max Life of Big Filter is 2000 Hrs / 1 Year Whichever is earlier)		✓				
39.		Clean	After cooler						✓
40.		Change	Vacuum Indicator					✓	
41.			HOSES IN AIR INTAKE SYSTEM					✓	
42.	Exhaust System	Check	Exhaust Leaks	✓					
43.			Exhaust Bellows & Change If Necessary				✓		
44.			Retorqued - Turbo Turbine side Clamp			✓			
45.		Clean	Exhaust Silencer				✓		
46.	Engine Related	Check	Tappet Clearance & Set if necessary			✓			
47.			External Fasteners Torque & do If Necessary			✓			
48.			Check Vibration Damper					✓	
49.			Alternator Greasing				✓		
50.		Change	Exhaust Silencer						✓
51.			Tappet Cover gasket			✓			
52.		Check & Record	Crank Shaft End Play (0.12 mm to 0.2 mm)					✓	
53.		Check & Change	Check Valve & Insert Condition, Change if necessary.(Check if any abnormalities found on valves)					✓	
54.			Check AVM & Change if necessary						✓
55.			Change Liners If Required						✓
56.			Change Piston Assembly If Required						✓
57.			Checking all critical fasteners change if Necessary						✓
58.			Check Push Rod Change if necessary						✓
59.			Check Tappets & Change if necessary						✓
60.			Check Rocker Lever & Change if necessary						✓
61.			Check Cam Shaft & Change if necessary						✓

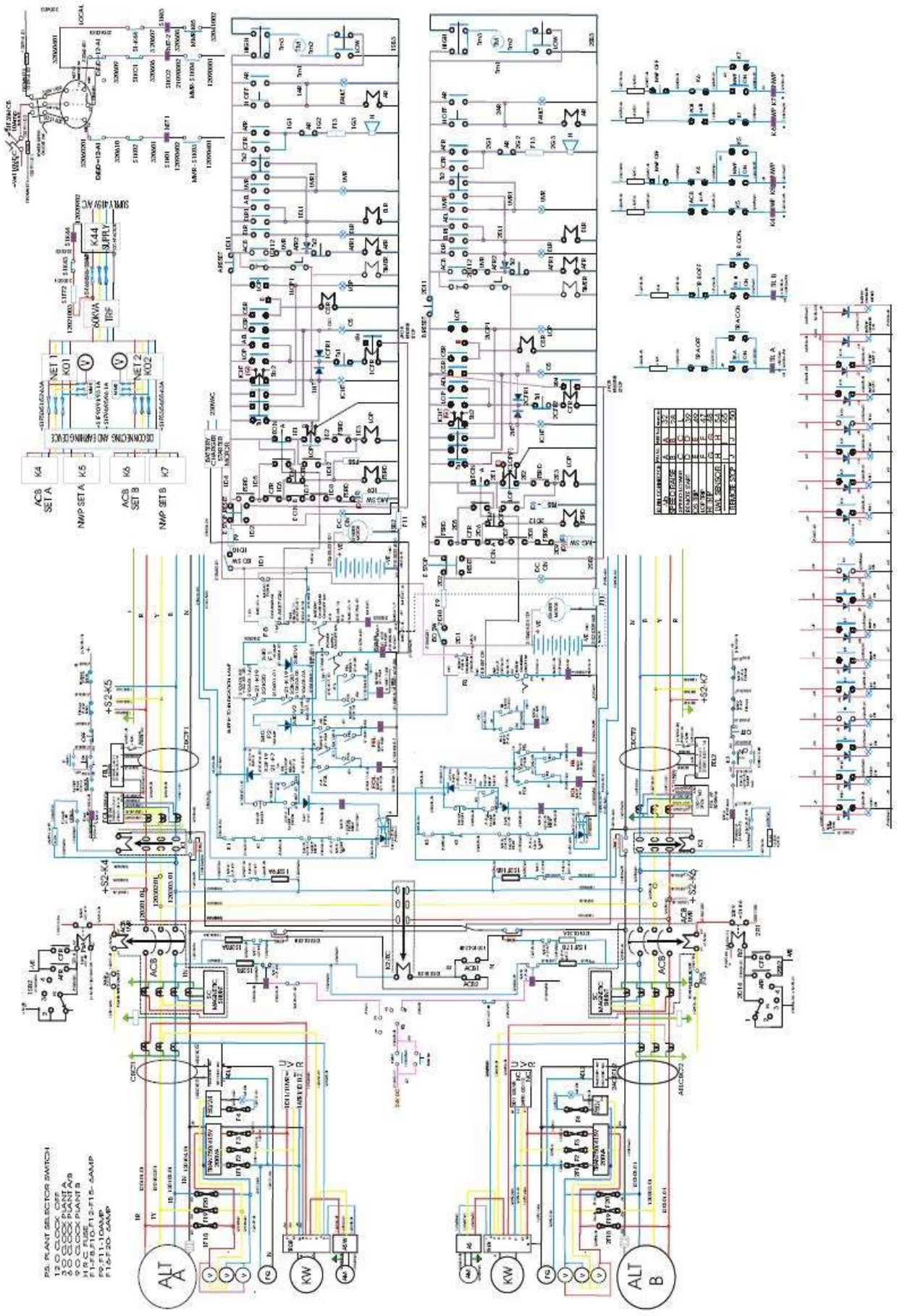
Sr. No.	Engine System	Check/ Clean/ Change/ Calibrate	Description	A	M1	M2	M3	M4	M5
62.			Check Connecting rod Big & Small end bearing change if required						✓
63.			MAIN COUPLING RUBBER ELEMENT					✓	
64.	Electrical System	Check	Battery Condition	✓					
65.			Specific Gravity of the Battery		✓				
66.			Battery Power Cable leads		✓				
67.		Check & Change	Over haul the Self Starter Motor.						✓
68.	Wiring & Panel	Check	Check & Correct- Panel Wiring			✓			
69.			Check EPS & Alarms			✓			
70.		Clean	Magnetic Pick Up Unit				✓		
71.		Check & Change	Sensors & Safety switch, Change if necessary					✓	

The above is as per OEM recommendation and may be suitably changed if the OEM issues any change. The recommendation of the OEM shall be final.

7.19 LIST OF MUST CHANGE ITEMS FOR POWER CARS

Sr No	Items	First POH	Second POH
DIESEL ENGINE			
1.	All types filters	Y	Y
2.	All types hoses as (oil, pressure, water)	Y	Y
3.	Inhibiter corrosion	Y	Y
4.	All rubber item	Y	Y
5.	All Gauges	Y	Y
6.	All Gasket	Y	Y
7.	All Connectors	Y	Y
8.	All clamps	Y	Y
9.	All side body filters	Y	Y
10.	AVM Pads	-	Y
Alternators			
1.	All ball bearings	Y	Y
2.	All rubber items (Capsules)	Y	Y
RE & Rad Motors			
1.	All Ball bearings	Y	Y
2.	All terminal plates	Y	Y
Fuel Pipe Line			
1.	All wheel valves	Y	Y
2.	Gaskets	Y	Y
3.	Fuel gauges	Y	Y


POWERCAR SCHEMATIC DIAGRAM (HT)
ALT A
ALT B
CBCT
ALT EARTH FAULT
ACB
ALT A
ALT B
TO COACH LOAD
WPC
K4
NWPC
K5
K6
NWPC
K7
WPC
K2
BUS COUPLER
RADIATOR CONT
60KVA
100A
K1
FEEDER A
FEEDER B
K3
CBCT
FEEDER A
FEEDER B
Z S COUPLING
COACH POWER CIRCUIT
FROM Z S COUPLING
FROM Z S COUPLING
FROM NET ½
DISCONNECTING AND EARTHING DEVICE
FUSE 1Kv-63 Amp
MMR
K03
750V A/C
1AMP
MMR
K04
750V A/C
NET1
K01
K02
NET2
750/415V 60KVA Tr
MMR
K45
415V A/C
100AMP
1AMP
K44
SUPPLY CONTACTOR
L S MAIN CONT
80AMP
K43
NORTH
L S CONT
K41
LOCAL SUPPLY SOCKET
K42
SOUTH
L S CONT
B/C CHARGER
A/C UNIT
LT-TR
COACH LOAD



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PANTRY CAR AND MINI PANTRY EQUIPMENTS

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CHAPTER 8

PANTRY CAR AND MINI PANTRY EQUIPMENT

8.0 INTRODUCTION

Pantry equipment are provided either in the separate pantry cars attached with the rake or in the coaches itself function as mini pantry according to the type of train and requirement of the passenger. The layout of these pantry cars and mini pantries has been approved by railway Board. EOG coaches are governed mainly by RDSO"s specification nos. ELPS/Spec/EOG/01, March 1994 and ELPS/Spec/EOG/02, November 1994. Pantry car equipment are governed by RCF"s Spec. EDTS-118E or its latest versions.

The basic pantry equipments provided in the LHB rake are as under:-

CHAIR CAR COACHES (Mini Pantry)

a) Hot case
b) Bottle cooler cum Deep Freezer
c) Water boiler, 30 litres capacity
d) Soup warmer

SLEEPER COACHES

a) Bottle cooler cum deep freezer
b) Hot case

PANTRY CAR

a) Hot case
b) Bottle cooler
c) Deep freezer
d) Fridge 300 litres capacity
e) Horizontal water boiler 3 nos
f) Water purifier
g) Hot plate 4 x 2000 W
h) Hot plate 1 x 5300 W
i) Electric chimney
j) Oven toaster griller
k) Insect killer

8.1 MINI PANTRY EQUIPMENT:

A minimum pantry compiling of hot case ,bottle cooler, hot water boiler and soup warmer are provided in each coach.

8.1.1 Hot Case

Hot case is meant to keep warm and warm up pre-cooked dishes in casseroles. Vegetarian and non-vegetarian dishes can be kept warm separately. In order to fulfill this requirement, hot case is divided into 3 or 2 separate parts. Temperature of these divisions is factory preset at 80°C, as per EDTS-118E.

Salient Features

Dimensions	:	910 x 1092 x 600mm
Voltage	:	230 Volt, 50 Hz
Heating element	:	3 x 500 Watt or 2 x 500 watt
Hot air blower	:	230 Volt, 50 Hz
Operating temperature	:	80°C
Thermostat	:	30 – 80°C
Trays	:	84 nos., 30 x 280 x 250mm stainless steel wire mesh.

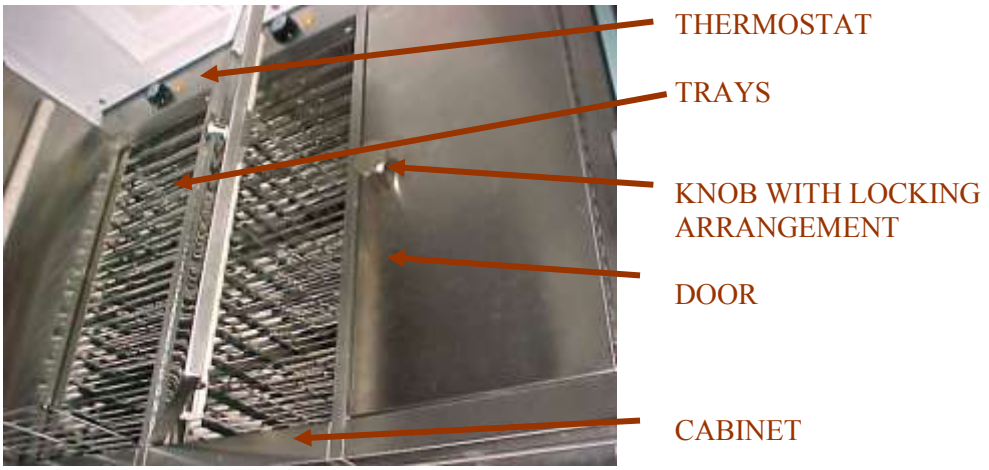


Figure 7.10 Hot Case

8.1.2 Refrigerating Unit

Modular pantry unit has a 230 liter capacity deep freezer with permanent temperature setting of at least -18°C to be used for freezing/ preserving ice cream/meat and food etc. Temperature setting range is from -18°C to - 25°C.

Salient Features

Dimension	:	1157 x 595 x 1195 mm
Power	:	800 Watt
Voltage	:	230 V 50Hz
Thermostat range	:	Deep freezer -18 to -25°C Bottle cooler 0 to + 10°C Cooling compartment 0 to +10°C
Refrigeration capacity	:	560k Cal/Hr.
Refrigerant	:	R22

8.1.3 Bottle Cooler

Bottle cooler is of 90 liters capacity to cool 1.0 liter mineral bottles to a temperature level of 3 to 5°C. Suitable arrangement has been made to prevent falling over/ rolling around of bottles inside the bottle cooler when bottle cooler is not completely filled up.

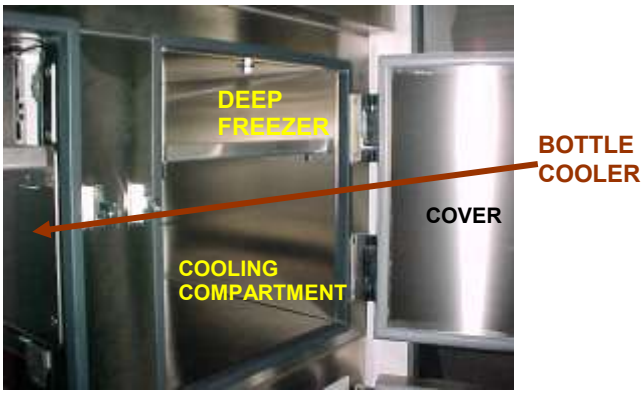


Figure 7.9 Refrigerating Unit

Dimensions	:	910 x 600 x 900mm
Max. Power	:	200 watts.
Operating Voltage	:	230V ±10%, 50 Hz
Thermostat range	:	3 to 5°C

8.1.4 Water Boiler

Water boiler of 30 liters capacity confirming to IS: 3412 is provided along with a control box and necessary plumbing and tap arrangement on a common base plate. There are three nos. of such boilers provided on side wall of coach. Inlet to one of the boilers can be used for preparing tea/ coffee. Base plate and plumbing are suitably modified to suit provision of water filter. Other two water boilers are connected directly to over head tank of coach with the help of flexible pipes. These are mainly used for cleaning purpose.

Salient Features

Capacity	:	15Litres
Power	:	230V AC+/-10%
Heating element	:	2KW
Thermostat	:	0-75°C
DIM.	:	525 x 300 x 285mm

Figure 7.8 Water Boiler in Original design Coaches

Vertical Water Boiler in Existing Design Coaches

8.1.5 Soup Warmer

Soup Warmer is divided in two major parts i.e. food insert and kettle insert. It is meant to keep warm and warm up the pre-mixed soup in the food insert. The heating medium is water which is to be filled between food insert and kettle insert. The lid should be kept close to prevent water loss. It is to be opened when refilling of food insert is required. Don"t operate the kettle in dry condition. Always turn the kettle control „OFF" when not in use.

Salient Features

Capacity	-	a. Food insert - 12 litres.
		b. Heating medium – 0.6 litres of water.
Maximum power	-	475 watts.
Nominal voltage	-	230 V ± 10%, 50 Hz
Nominal current	-	2.2A
Weight	-	4.5 kg
Thermostat range	-	Lower temperature range 70-72°C High temperature range 90-92°C
Thermal insulation	-	Bonded mineral wool

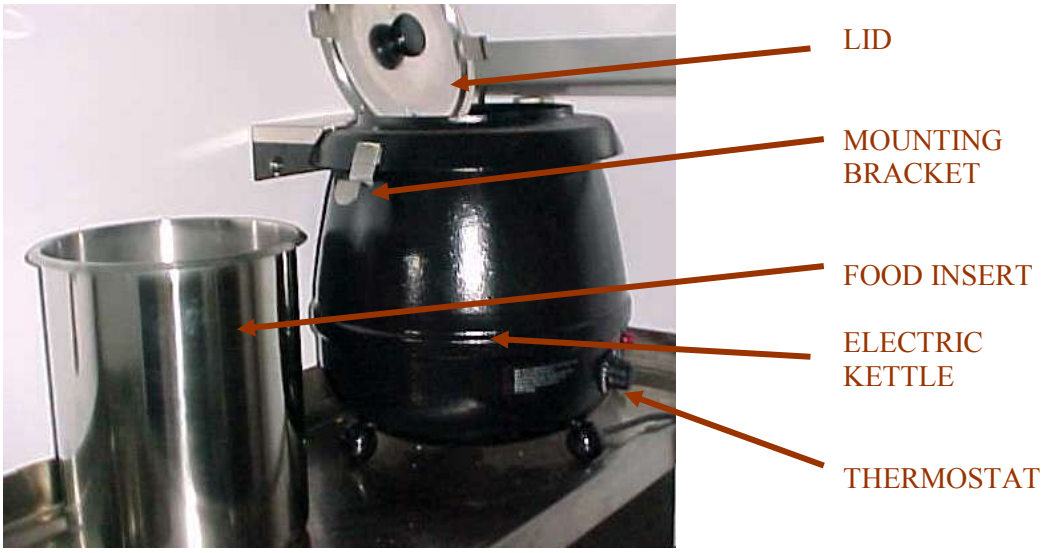


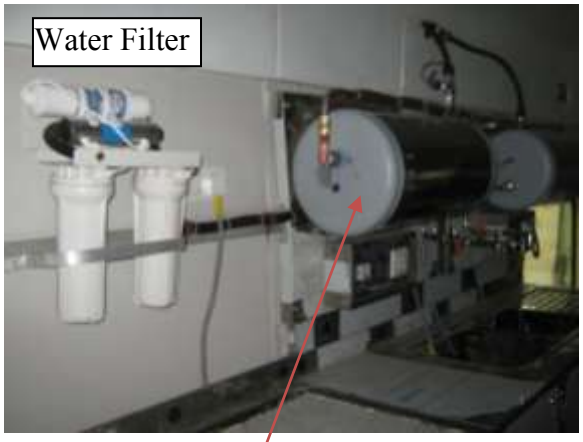
Figure 8.1 Soup Warmer

8.2 INTEGRATED MODULAR PANTRY EQUIPMENT

Integrated Modular Pantry Unit for buffet car comprises the following equipment:

a) Hot case
b) Bottle cooler
c) Deep freezer
d) Fridge 300 litres
e) Horizontal water boiler 3 nos.
f) Water purifier
g) Hot plate 4 x 2000 W
h) Hot plate 1 x 5300 W
i) Electric chimney
j) Oven toaster griller
k) Insect killer

Pantry arrangement of AC Buffet Coach



Hot Water Boiler

Pantry Arrangement of AC 2Tier & 3Tier coaches

Item a) to f) are similar to mini pantry equipment and have been described in para 8.2. The description of other equipment is as follows:-

8.2.1 Cooking and Service Table Assembly

Integrated cooking and service table assemblies comprise the following:

i.	Cooking table with electric hot plate 2.0 kW x 2 (LH)	1 no.
ii.	Cooking table with electric hot plate 2.0 kW x 2 (Centre)	1 no.
iii.	Cooking table with electric hot plate 2.0 kW x 2, 1.1 kW x 1 (RH)	1 no.
iv.	Service table with waste bin (LH)	1 no.
v.	Service table with waste bin (RH)	1 no.
vi.	Structural frame with front screen and 3 nos. chimneys, one in each burner suitable for operation in recirculation mode with active carbon filters	1 set

Cooking Table with Electric Hot Plates

General arrangement and mounting/ overall dimensions are as per drawing nos. LH 72213, LH 72214 and LH 72215 as per latest revision.

Cooking table is divided in three parts. Cooking tables are provided with hot plates of the reputed approved make of the following ratings:

i) 2.0 kW – total 04 nos. (2 nos. in centre table and 02 nos. in RHS table)
ii) 5.3 kW – total 1 nos. (1 x 2 kW centre & 1.1 kW x 3 around centre plate in LHS table).

Height of utensil base support is kept minimum to prevent heat loss through gap.

Suitable thermal insulation is provided below heat zones to avoid overheating of adjoining areas and prevent heat loss.

All cooking tables are provided with individual control boxes which include the following switchgear/ control gear:

Rotary Switch	-	Siemens/ Salzer
Indicator – green	-	GS/ Allen Bradley / Teknic
ELCB	-	Siemens/ MDS/ L&T

Wiring schematic diagram is shown in drawing (Annexure – A) with copper bus bar, copper wire, porcelain beads & Teflon insulated cables of suitable ratings. Terminals for incoming and outgoing cables shall be suitable for heating appliances and of suitable rating.

Service Table with Waste Bin (LH & RH)

Overall general arrangement and mounting dimensions of service table are as per drawing no. LH 72216. A removable type waste bin of stainless steel of size 350 x 450 x 400 mm is provided in each service table. Securing arrangement of the waste bin is such that it does not make rattling sound due to vibrations.

It is provided with handles to empty the contents inside the container easily. The rest of space beneath the top is converted into storage racks with doors. A folding type top is attached to the service table (RH). This folding type top shall have interface with the coach partition frame for which resting arrangement with necessary back pieces are provided inside the pantry coach.

Hand rail supports are also provided for support to staff and to prevent falling of items during train run.

8.2.2 Integrated Structural Frame

Assembly of the tables is done by employing continuous structural frame to give a modular appearance. A protective screen in front of hot plates is provided to form a partition between the cooking areas and the corridor. The cooking table assembly is provided with a frame for mounting chimneys over each burner. The frame is so designed that it does not obstruct with the cooking personnel while cooking.

8.2.3 Catering and Service Counter

Catering and service counter are made in two parts. It is manufactured on a robust stainless steel frames of angles covered with stainless steel sheet for adequate strength of table top. The catering counter (LH & RH) assembly is provided with a hinged flap for entrance in the counter. The counter is mainly required for placing hot and cold dispensers by the vendors.

8.2.4 Storage Compartment with Sinks

In modular unit of kitchen, front openable cupboards/ racks with adjustable type shelves as shown in figures are provided. Stainless steel drawn type sinks of following sizes are provided.

i)	610 x 460 x 250	-	1 Nos. Grace – Jumbo of M/s Nirali (or equivalent approved make)
ii)	410 x 365 x 200	-	1 Nos. Elegance of M/s Nirali (or equivalent approved make)
iii)	300 x 300 x 125	-	1 Nos. Square unique of M/s Nirali

(or equivalent approved make)

Sink units have been provided with fixed type splash guards suitably integrated with units. Height of splash guards is kept as 175 mm.

Stainless steel fabricated top openable waste bins with covering lids are provided in storage rakes.

Overall sizes of containers are as follows:

Length = 550 mm

Width = 535 mm

Height = 280 mm

Containers are of sliding type design with suitable handles for frequent and easy removal and cleaning purpose. Suitable measures have been taken to prevent rattling sound of these containers. Other storage rack is without waste bins.

Top of racks have continuously smooth work surface with finely curved edge at front side while in completely assembled condition inside the coach.

8.2.5 Oven Toaster Griller

An oven toaster Griller of standard make is provided in the pantry to bake the dishes as per requirement

Figure: Oven Toaster Griller

8.2.6 Insect Killer

Two nos. of insect killers of suitable make are provided on the panty wall at both ends of cooking place to catch and kill the flies and insects and keep the pantry insect free.

Figure: Insect Killer

8.3 JOINT PROCEDURE ORDER FOR PROPER UPKEEP OF PANTRY CARS AND MINI-PANTRIES

Local JPO at Zonal railway level should be issued along with commercial department considering following minimum points for proper upkeep of Pantry Cars & Mini-pantries are as follows:

A Responsibility of Electrical Staff

1. Panels should be locked by electrical staff after pantry service and will be opened whenever required for maintenance purposes.
2. Electrical staff will ensure proper rating of MCBs, overload relays and contactors and should not allow isolation of any MCB, overload relay and contactors in panels.
3. Filters of chimney should be cleaned regularly after every trip.
4. Regular checks of wiring, fittings and fuses/ MCBs of pantry car & mini-pantries should be ensured.
5. Electrical staff in pantry car should lock hot plate switch and MCB at notified time in the night and morning. Lock should be opened by Electrical staff duly making entry in register and should be signed by Electrical staff and Pantry manager.

B Responsibility of Pantry Staff

1. All pantry equipment should be cleaned regularly before putting food stuff and after use.
2. Pantry staff to ensure that panel area shall be kept clean all the time and pantry equipment should never be crowded by putting other utensils/boxes near them as it hinders their proper operation and result in premature failure.
3. Overloading of refrigerators, deep freezers, bottle coolers and hot cases should not be allowed.
4. Paper trays, polythene bags etc should not be put in hot cases as this may result in fire.
5. Safety devices fitted in equipment (Thermostats, Pressure switches, fuses & MCBs) shall not be tampered by pantry staff. In case of any failure, electrical staff should be contacted for assistance.
6. Pantry staff should ensure safe operation of all pantry equipment. No short cuts such as appliances without plug etc should be used.
7. After completion of work, electrical equipment should be switched OFF by the respective pantry staff.
8. Pre heated meals/snacks and pre cooled water bottles/Ice cream etc should be kept in the pantry appliances
9. Trays of insect catchers should be cleaned regularly.
10. Water boilers shall be operated only after ensuring availability of water.

11. Mishandling of equipment shall be avoided, as this results into damage to doors/locks and wiring.

12. Pantry car staff shall use flat bottom utensils with larger diameter than hot plate.

13. Oil container shall not be kept near hot plate or at the floor of cooking area.

Caution :

- Pantry car cooking staff should take utmost care while handling with oil. There should not be any oil spill on or near Electric hot plate as it may cause fire.
- The container of oil should be in store in pantry car only.

C Common Responsibility

1 No smoking should be allowed in pantry cars.

2 No inflammable items should be carried in pantry cars.

3 Ensure proper closing of panel doors, defective/rattling doors should not be allowed.

4 No extra electrical equipment except standard scale should be connected in any case. No temporary wiring for power supply to any kitchen appliance is permitted.

5 While taking/handing over of charge, Pantry Manager and Electrical supervisor shall ensure all above, prepare a joint handing over/taking over sheet and keep proper records for deficiencies, if any.

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DOORS AND INTERIOR FITTINGS

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CHAPTER 9

DOORS AND INTERIOR FITTINGS

9.0 DOORS FOR LHB COACHES

The various kind of doors used in LHB coaches are-

i) Entrance doors
ii) Saloon doors
iii) End wall doors
iv) Pantry doors
v) Lavatory doors
vi) Switch board doors

Their detailed description and maintenance requirement are given below.

9.1 ENTRANCE DOORS

Construction

Entrance Door comprises of single shutter openable towards the inside of Coach with manual handling, alongwith pivot pins fitted on the top and bottom of the door frame.

Door leaf of Entrance door has

- Sandwich construction with stainless steel frame.
- The external surface is made by painted stainless steel sheet.
- The internal surface is made up of glass filled reinforced plastic sheet with gel coating finish.
- The core is composed of thermo reactive foam filled between the internal and external surfaceS.

The door is equipped with releasing double bolt type lock controlled by a middle lock. The lock is operated by means of brass casting handles. The door can be locked from the interior as well as exterior side with the help of a square key.

The door-window is comprised of fixed type tempered glass, alongwith internal safety glass glued to the frame by means of sika flux.

The steps is comprise of aluminum channels covered with stainless steel sheet on the both sides and is having a sandwich construction of thermo reactive foam placed between external and internal sheets.

9.1.1 Maintenance Instructions

Procedure for checking the integrity of the door assembly:

- Check the mechanical structure of the doors and check the integrity,
- Verify the correct tightness of all the bolts and nuts,
- Ensure smooth opening of the door lock by the handle. Verify the smoothness and the correct alignment of the door alongwith insertion of the locking cam top and locking pin bottom with the lower locking provided on the door frame. If it is necessary, set the shutter (diagonally and vertically).
- Check the square lock device by means of square key.
- Keep the lock greased from the pockets provided on the side of the lock.

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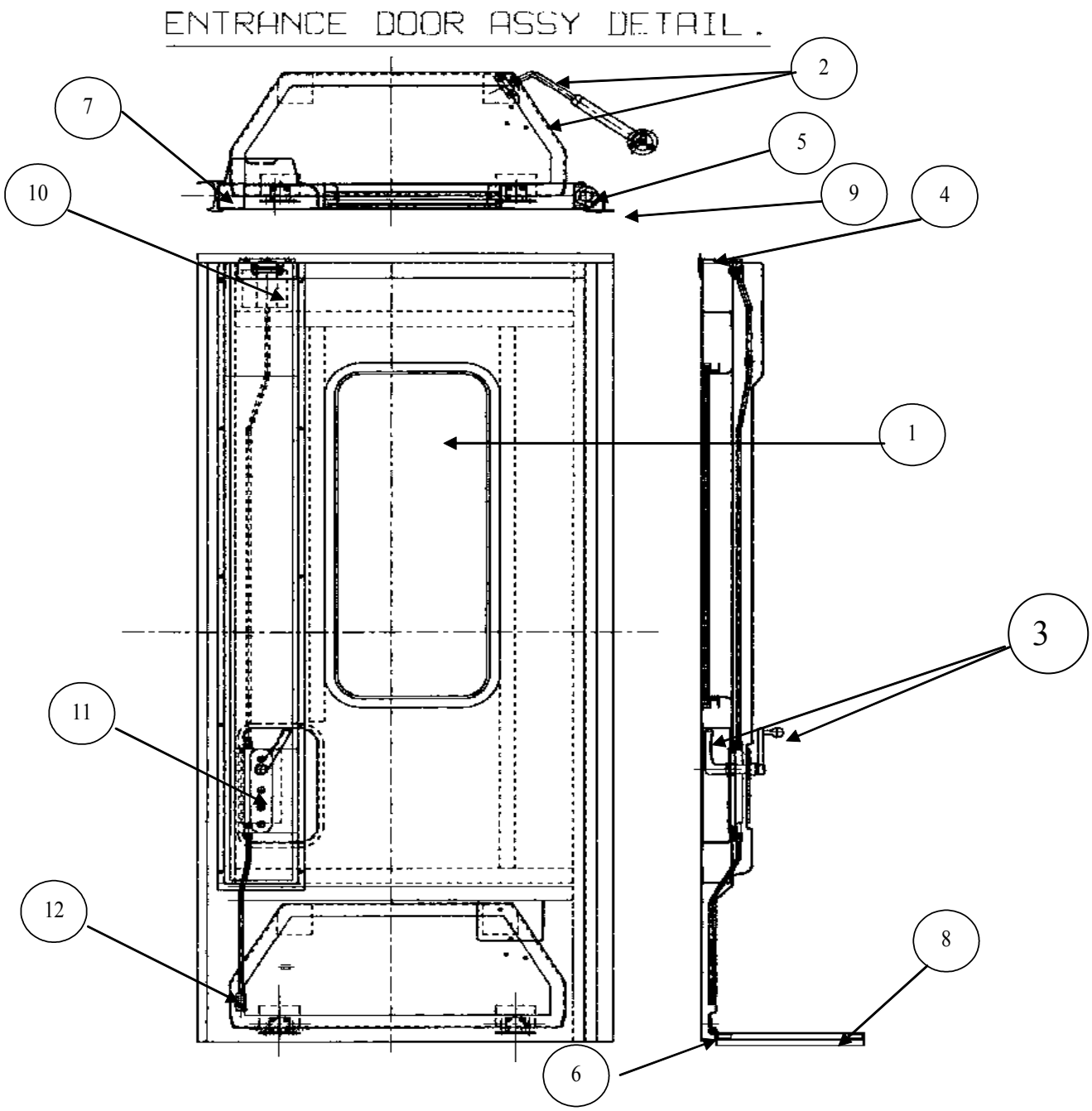


Figure 9.1

9.1.2 Spare Parts for Entrance Door

S.No.	Descriptions	Qty./Door
1	Glass	1
2.	Pivoted Arm Complete	2
3	Handle Assembly	1
4.	Facing Brick Gasket	2
5.	Pivot Pin Top Assembly	2
6.	Pivot Pin Bottom Assembly	2
7.	Hand Safe Gasket	2
8.	Gasket Foot Step	2
9.	Gasket Hinge	3
10.	Locking Set Top	1
11.	Locking Set Middle	1
12.	Locking Set Bottom	1

9.2 SALOON DOORS

Saloon sliding door comprises of sliding shutter operated by manual handling and has automatic return movement.

Door leaf built by stainless steel sheet sections welded by Tig welding, having sandwich construction filled with thermo reactive foam alongwith hardened safety glass applied to the frame by means of EPDM rubber gasket with locking string.

The shutter carries external and internal handles of stainless steel sheet metal/pipe along with hand-safe gasket.

Ventilation grid made up of Aluminum extrusion is provided for air passage applied on the bottom of the shutter by means of EPDM rubber gasket alongwith screws.

The shutter has a lock, for the locking of door in closed and opened position, actuated by square key.

On the external side, it‟s possible to lock the door by applying external lock with the brackets provided on the top of the door leafs.

Lower Guidance **c**omprises of MS „T‟ section, hard chrome plated, which is fixed in the floor by means of screws.

Sliding Mechanism consists of

- Supporting MS plate with power coating.
- Steel pulleys.
- Aluminum guide assembled with linear motion bearings travels on chromated steel bar.
- Nylon String with Natural Rubber Strands and Nylon Sheath.
- The movement of the shutter is carried by means of the nylon string assembled in the pulleys.

Braking cylinder acts as pneumatic brake in opposition of backward movement of the doors obtained by an elastic rope. The backward movement can be adjusted by means of unidirectional flow regulation valve fitted with the short circuit pipe which connects the cylinder chamber realising the short circuit and allow the automatic controlled movement of shutters.

9.2.1 Periodic inspection

- Check the mechanical structure of the doors and check the integrity, especially in connection with the drag suspension support.
- Verify the correct tightness of all the bolts and nuts, especially concerning the fixing of the supporting shaft, the basement plate of the upper guidance and the pulleys support.
- Open and close by the handle verifying the smoothness and the correct insertion of the hand safe gasket with the sheet metal profile fixed on the side wall. If it is necessary, set the shutter (diagonally and vertically) by the suspension support / shutter bolt.
- Check the square lock device by means of square key.
- Execute carefully a visual check of the braking cylinder (connections, pipe and valve).
- Check the integrity of the elastic thread.
- Check the functioning of self backward system by opening and closing the door several times.
- Keep the lower guidance cleaned.
- Keep the guidance shaft cleaned by a clean cloth and liquid detergent. After cleaning, dry the shaft surface well.

Note: The guidance shaft doesn‟t need greasing and / or lubrication. The use of greasing or lubrication keeps the dust over the shaft.

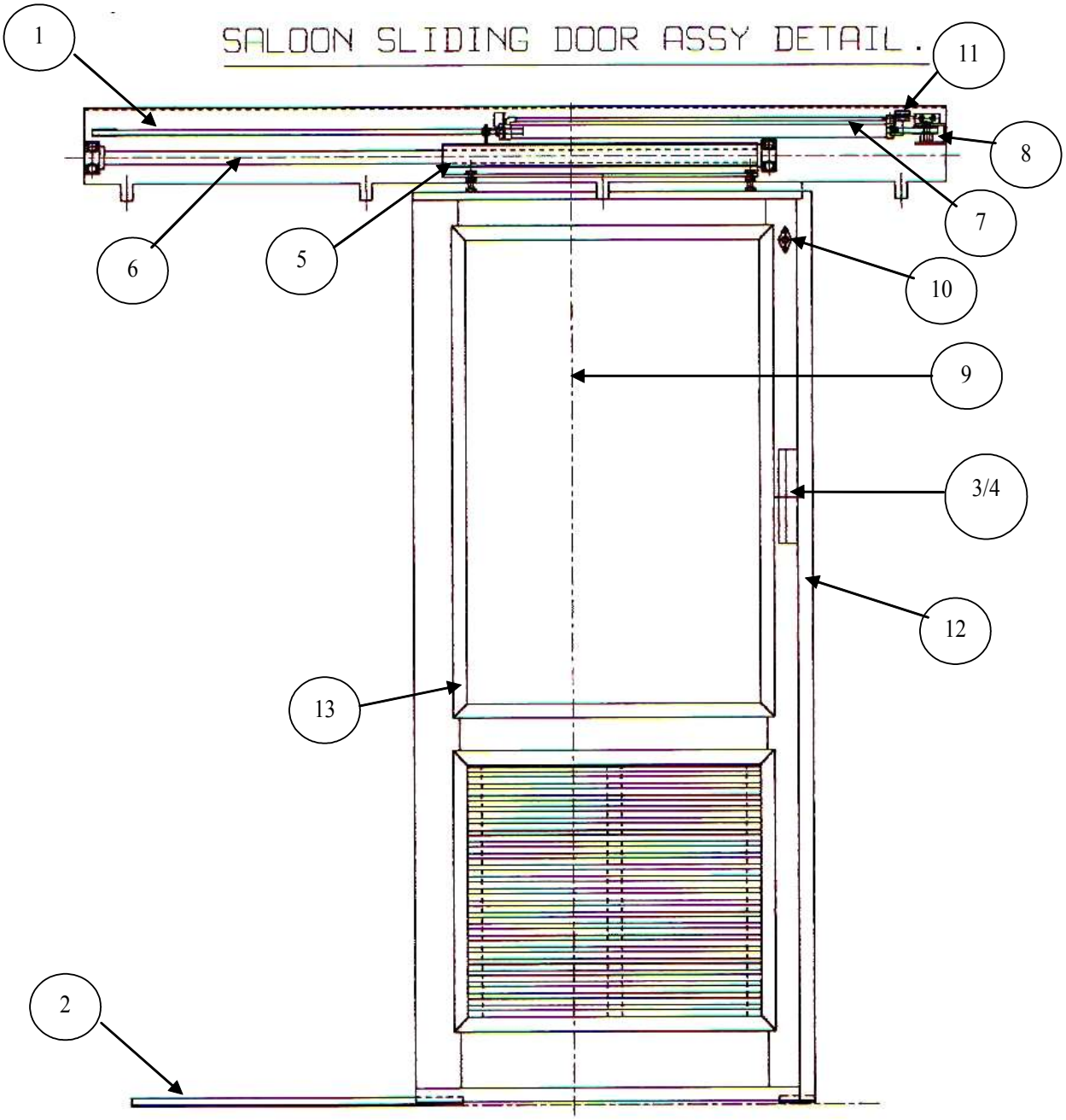


Figure 9.2

9.2.2 Spare Parts for Saloon Sliding Door

Sl No	Description	Qty. / door
1	Elastic Wire	3
2	T-rail / Guide Rail	2
3	Internal Handles	1
4	External Handles	1
5	Guide Complete with LM Bearing	1
6	Chromated Shaft	1
7	Pneumatic Cylinder	1
8	Pulley Nylon String	4
9	Toughened Glass	2
10	Lock Set	1
11	Cylinder Mounting Bracket	2
12	Hand safe Gasket	2
13	Glass Gasket	4

9.3 ENDWALL DOORS

Endwall doors comprise of two sliding shutters operated by manual handling and have automatic return movement.

Door leaf of Endwall door has Sandwich construction with a AISI 304 stainless steel frame. External and internal surface in stainless steel have sandwich construction of Thermo Reactive foam.

One of the two shutters has a lock, for locking of the door, actuated by square key.

Each shutter has a replaceable toughened and transparent glass window, with stainless steel frame riveted with the front sheet.

Lower guides Comprise of MS „T‟ section, hard chrome plated, which is fixed in the floor by means of screws.

Sliding Mechanism consists of

- Supporting MS plate with powder coating.
- Steel pulleys .
- Aluminum guide assembled with linear motion bearings, travels on chromated steel bar.
- Nylon String with Natural Rubber Strands and Nylon Sheath
- Serrated belt of 5 mm pitch made up of polyurethane material is reinforced with steel strands.
- The simultaneous movement of the two shutters is carried by means of the serrated belt assembled in pulleys.

A Braking cylinder acts as pneumatic brake in opposition of backward movement of the doors obtained by an elastic rope. The backward movement can be adjusted by means of unidirectional flow regulation valve, fitted with the short circuit pipe, which connects the cylinder chamber realising the short circuit, and allow the automatic controlled movement of shutters.

9.3.1 Periodic Inspection

- Check the mechanical structure of the doors and check the integrity, especially in connection with the drag suspension support.

- Verify the correct tightness of all the bolts and nuts, especially concerning the fixing of the supporting shaft, the basement plate of the upper guidance and the pulleys support.

- Open and close by the handle, verifying the smoothness and the correct insertion of the male / female gaskets.

- Check the square lock device by means of square key.

- Check the functioning of self backward system by opening and closing the door several times.

- Check the belt tensioning. If necessary, adjust by means of the setting screw on the setting pulley.

- Examine the Braking cylinder mechanism for correct functioning and any loose connections.

- Keep the lower guide rails cleaned. Do not apply grease or oil as it leads to accumulation of dust.

- Keep the guidance shaft clean by a cloth and liquid detergent. After cleaning, dry the shaft surface well.

  Note: The guidance shaft doesn't need greasing and / or lubrication.

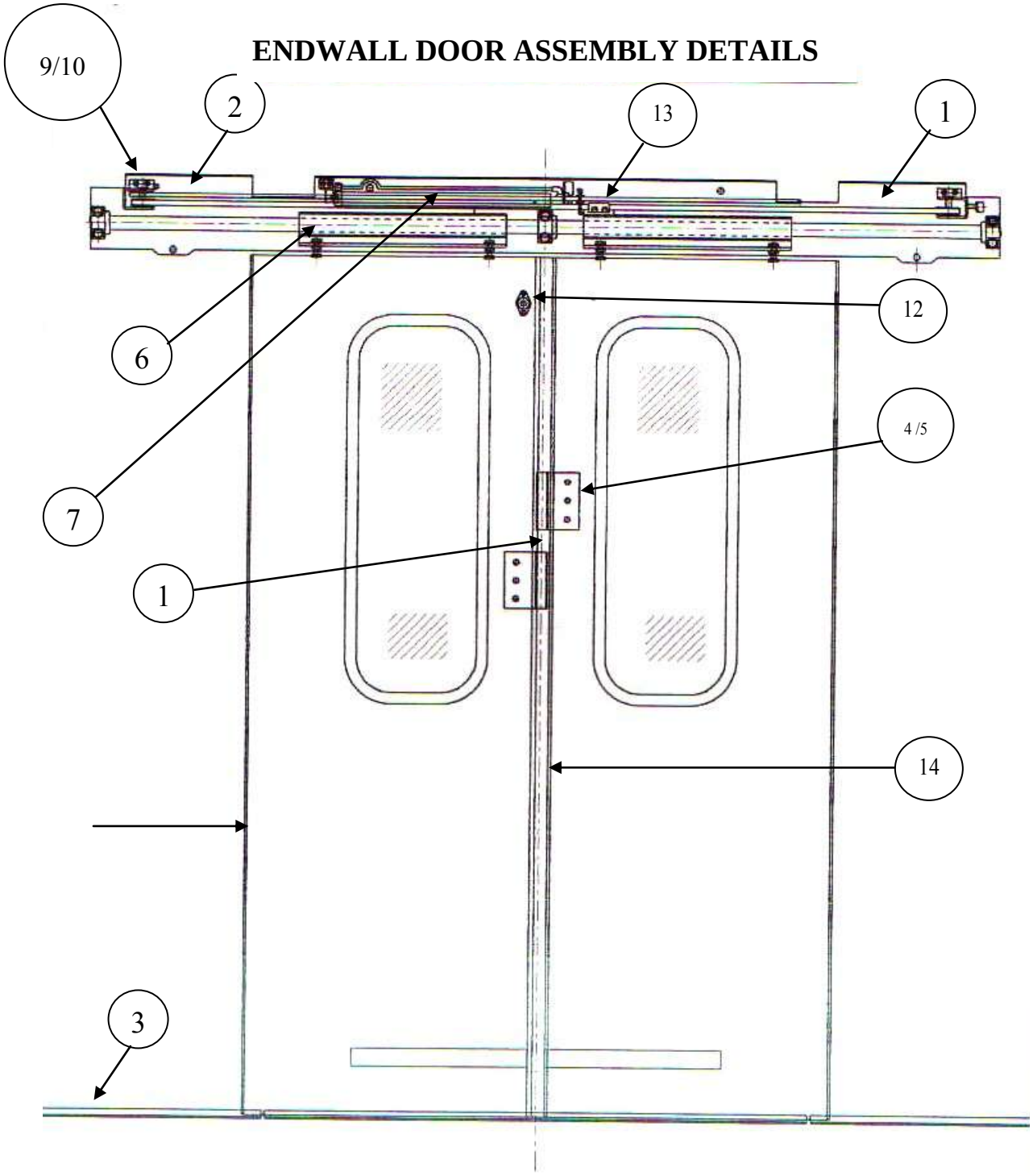


Figure 9.3

9.3.2 Spare Part list for End wall Door

Sl No	Description	Qty. / door
1	Reinforced Serrated Belt Pitch 5mm	3
2	Elastic Wire	3
3	T-rail / Guide Rail	2
4	Internal Handles	1
5	External Handles	1
6	Guide Complete with LM Bearing	1
7	Chromated Shaft	1
8	Pneumatic Cylinder	1
9	Pulley Serrated Belt	4
10	Pulley Nylon String	4
11	Toughened Glass	2
12	Rod for Pad Locking	1
13	Lock Set	1
14	Internal Drag Plate	2
15	Hand safe gasket Male / Female	2
16	Wiper Gasket	2

9.4 PANTRY DOORS

Pantry door comprise of two sliding shutters operated by manual handling and have automatic return movement.

Door leaf of Pantry door has Sandwich construction with Aluminium Extrusion Frame. External and internal surface is covered with Aluminium Sheet and have sandwich made of Thermo Reactive foam.

The shutter carries external handles of stainless steel sheet metal and internal handles in bronze along with handsafe gaskets.

Ventilation grids made up of Aluminum extrusion are also provided for the air passage applied on both the shutters by means of screws.

One of the two shutters has a lock for the locking of the door, actuated by square key. On the external side it‟s possible to lock the door by applying external lock with the brackets provided on the top of the door leafs.

Lower guides comprise of MS „T‟ section, hard chrome plated, which is fixed in the floor by means of screws.

Sliding mechanism consists of

- Supporting MS plate with powder coating.
- Steel pulleys .
- Aluminum guide assembled with linear motion bearings, travels on chromated steel bar.
- Nylon String with Natural Rubber Strands and Nylon Sheath

- Serrated belt of 5 mm pitch made up of polyurethane material, reinforced with steel strands.
- Simultaneous movement of the two shutters is carried by means of the serrated belt assembled in pulleys.

A Braking cylinder acts as pneumatic brake in opposition of backward movement of the doors obtained by an elastic rope. The backward movement can be adjusted by means of unidirectional flow regulation valve, fitted with the short circuit pipe, which connects the cylinder chamber realising the short circuit and allows the automatic controlled movement of shutters.

9.4.1 Periodic Inspection

- Check the mechanical structure of the doors and check the integrity, especially in connection with the drag suspension support.
- Verify the correct tighten of all the bolts and nuts, especially concerning the fixing of the supporting shaft, the basement plate of the upper guidance and the pulleys support.
- Open and close by the handle, verifying the smoothness and the correct insertion of the male / female gaskets.
- Check the square lock device by means of square key.
- Check the self backward system by opening and closing the door several times.
- Check the belt tensioning. If necessary, adjust by means of the setting screw on the setting pulley.
- Examine the Braking cylinder mechanism for correct functioning and any loose connections.
- Keep the lower guide rails cleaned.
- Keep the guidance shaft cleaned by a clean cloth and liquid detergent. After cleaning dry the shaft surface well.

  Note: The guidance shaft doesn't need greasing and / or lubrication.

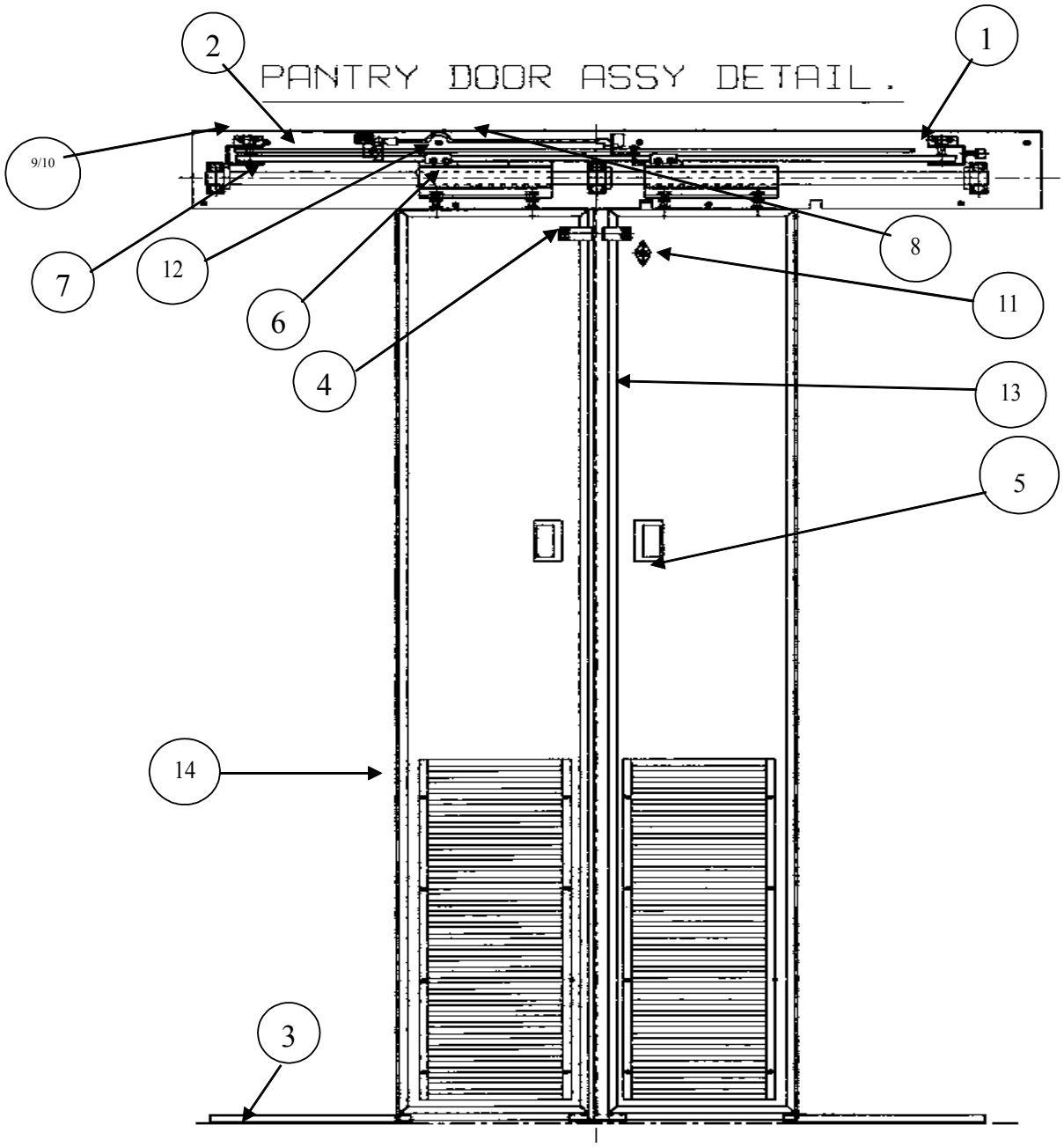


Figure 9.4

9.4.2 Spare Part list for Pantry Door

Sl No	Description	Qty. / door
1	Reinforced Serrated Belt Pitch 5mm	3
2	Elastic Wire	2
3	T-rail / Guide Rail	1
4	Lock Bracket	1
5	External Handles	1
6	Guide Complete with LM Bearing	1
7	Chromated Shaft	1
8	Pneumatic Cylinder	4
9	Pulley Serrated Belt	2
10	Pulley Nylon String	1
11	Lock Set	2
12	Internal Drag Plate	2
13	Handsafe Gasket Male / Female	2
14	Wiper Gasket	2

9.5 LAVATORY DOORS

Lavatory door comprises of two folding shutters for closing of the Lavatory room, operated by manual handling, and have movement along the pivot pin made up of stainless steel material, fitted along the extrusion block middle of the door leafs

Door leaf is built by aluminum extrusion frame by Tig welding, having sandwich construction filled with thermo reactive foam, alongwith covering of Aluminum sheet fitted in the extrusion on both side.

The shutter carries external and internal handles of brass casting alongwith hand safe gasket.

Ventilation grid made up of Aluminum extrusion is provided for the air passage, applied on the bottom of both the shutters by means of screws.

The door is equipped with release lock which can be closed from inside by knob and outside by square key.

The movement of the door is guided by „U‟ linear guide and by a support with a nylon roller fixed on the door.

9.5.1 Periodic Inspection

- Check the mechanical structure of the doors and check the integrity,
- Verify the correct tightness of all the bolts and nuts,
- Open and close the door by the handle, verifying the smoothness and the correct alignment of the hand safe gasket and insertion of the locking pins top and bottom with the frame, and also insertion of the limit switch actuating rod in the side wall.
- Check the smoothness of the door by opening and closing the door several times.
- Check the lock device by means of square key.
- Keep the frame extrusions cleaned to avoid hindrance to the door with the frame.

- Keep the lock greased from the pockets provided on the side of the aluminum extrusion frame.

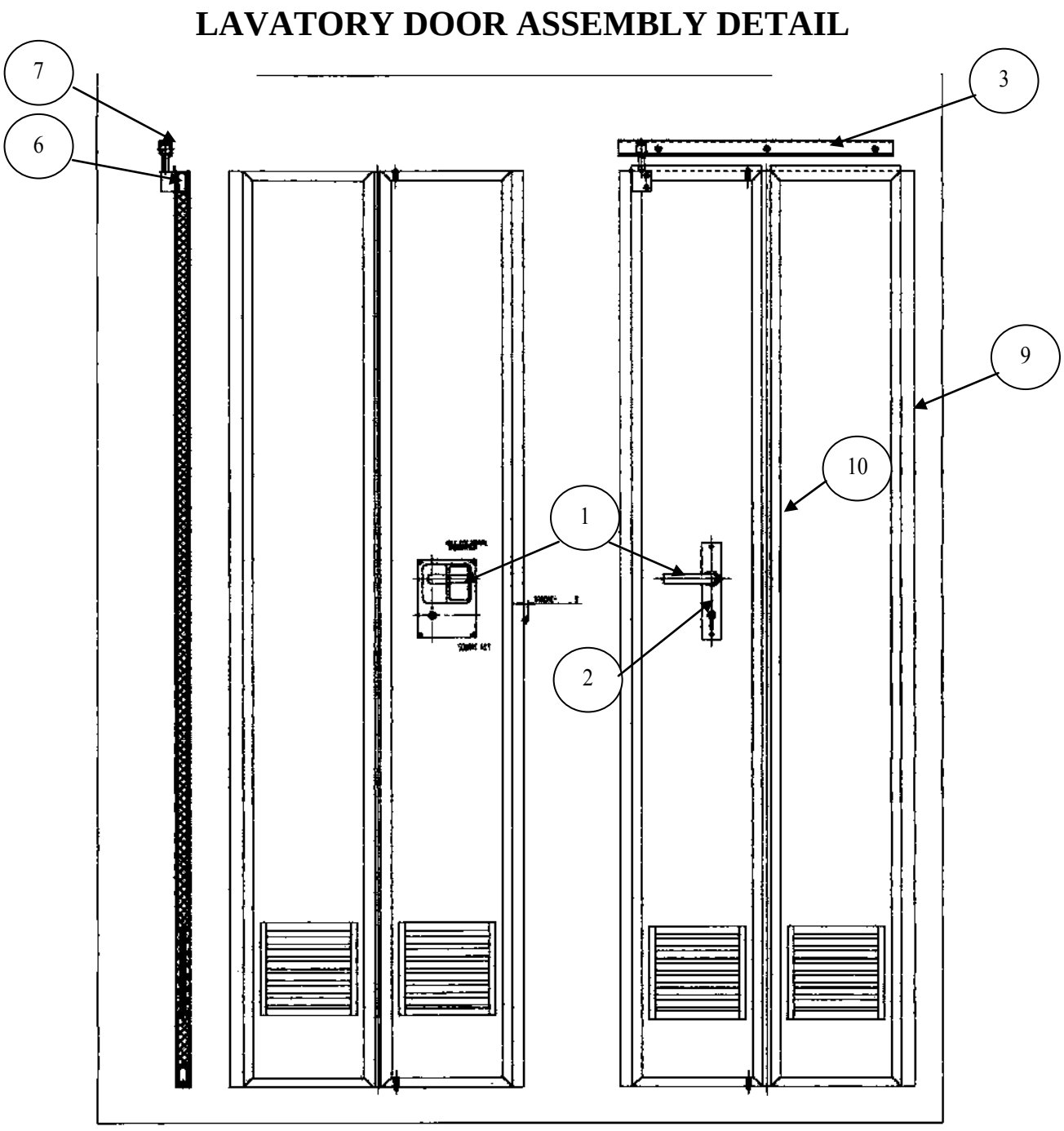


Figure 9.5

9.5.2 Spare Part list for Lavatory Door

S.No.	Description	Qty/Door
1.	Handle Assembly	2
2.	Lock assembly	1
3.	U Frame Roller Guide	1
4.	Pivot Top	1
5.	Pivot Assembly Bottom	1
6.	Nylon Rollers	1
7.	Roller Block Assembly	1
8.	Frame Assembly with locking Plates	1
9.	Hand Safe Gasket	4
10.	Gasket Hinges	4
11.	Limit Switch	2

9.6 SWITCH BOARD DOORS

Switch board door is of wooden sandwich construction of High pressure laminated sheet on wooden board, with properties like termite resistant, water resistant and weather resistance. The door is foldable in a zip construction towards the inside of the panel with manual handling along the double stainless steel hinges fitted on the side and middle of the two door leafs. The door is fitted with brass handle embedded in wooden leaf.

The door contains releasable double bolt type lock, controlled by a middle lock.The lock is operated by means of square key.The door can be locked from the exterior side with the help of a square key.

The door is comprised of two nos. moveable type tempered glass.

Rubber protection beading is also provided along the wooden door frame, glued to the frame by means of self adhesive tape.

Ventilation grid made up of Aluminum extrusion is provided for the air passage, applied on the bottom of both the shutters by means of screws.

9.6.1 Periodic Inspection

- Check the structure of the doors for integrity,
- Verify the correct tightness of all the bolts and nuts.
- Ensure smooth opening of the door lock by the square key. Verify the smoothness and the correct alignment of the door along with insertion of the locking pin top and locking pin bottom with the locking plate provided on the coach
- Check the smoothness of the door by opening and closing the door several times.
- Check the square lock device by means of square key.

- The Rubber extrusions to be cleaned with care to avoid damage.
- Keep the lock greased from the pockets provided on the side of the lock.

SWITCH BOARD DOOR ASSEMBLY DETAIL

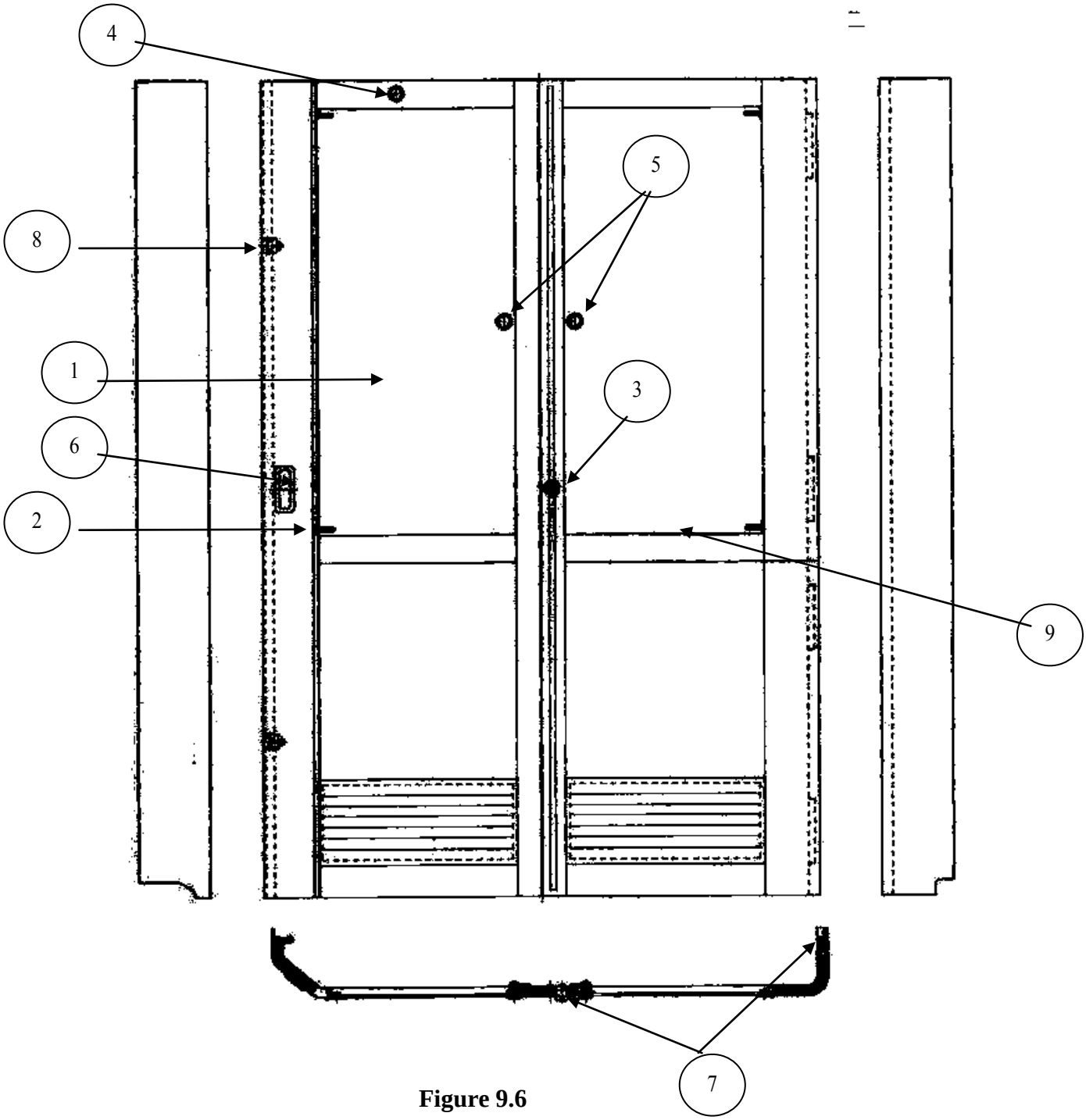


Figure 9.6

9.6.2 Spare Parts for Switch Board Door

Sl No	Description	Qty. / door
1	Toughened Glass	2
2	Glass Hinge	4
3	Lock Assembly Middle	1
4	Lock Assembly Top	2
5	Lock Glass	2
6	Handle	1
7	Hinge Assembly	2
8	Ball Catchers	4
9	Glass Protection Gasket	2

9.7 SEALED WINDOW GLASS UNIT

Three types of windows have been used in LHB coaches.

1. Fixed window unit with sealed glass, 12 per coach
2. Emergency open able window, 4 per coach
3. Hopper type windows for lavatory, 3 per coach

Hopper Type Window

The sealed unit consists of outer 8.4 mm laminated glass and inner 4 mm tempered safety glass with 6 mm air gap with Krypton/Argon gas filling. Glasses are held by an aluminum extrusion frame with rubber profile.

Emergency window is similar to the fixed unit. Four units are provided in each coach to allow emergency evacuation of passenger. A handle is connected to the rubber profile to open the glass unit of the emergency window. The breakage of glass unit while opening is prevented by a restraining chain.

Maintenance of Windows

- Broken, cracked, defaced or scratched glass should be replaced and the window frame repaired as necessary. The rubber or felt lining between the glass and the frame should be changed every time the glass is removed.
- In case of separate outer window, before fitting it, sealing compound should be applied on the joint surfaces of the coach as well as the window to form an air-tight joint. Sun control film should be pressed on the inside of outer glass.
- The hinges of inner window frame should be checked for easy operation and well oiled before refitting. The clamping catches should be attended to and tested for proper functioning.
- The rubber beading between window and coach body should be replaced if found set, deteriorated, or damaged, to ensure air tightness.
- The damaged FRP inner frames / holding frame should be replaced. The moulding on the window space between the outer and inner windows should be replaced if found deficient or damaged.

9.8 ROLLER BLINDS

Roller blinds have been provided on the windows in AC Chair cars instead of curtains.The roller blind is manually operated. These blinds have three positions i.e. full open, half open and full closed.

9.9 LUGGAGE RACKS

In LHB coaches, the luggage racks are made from aluminum extrusions and tempered safety glass.
It can withstand distributed load of 1000 N (100 kgs) per meter length and point load of 850 N (85 Kgs) as per UIC 566.

9.10 SEATS FOR CHAIR CAR COACHES

There are 78 chairs in the II AC chair car and 56 chairs in Executive class arranged in rows of 2 and 3 chairs. Weight of a single chair car for II AC chair car is approximately 21 kg.
The height of the seat cushion above floor level (450 mm), the width between the arm rests (420mm and 500 mm in Exe.class) and the ergonomically designed upholstery allows an excellent seating comfort

Main assembly comprises –

- Welded frame with foot and wall fixing arrangement
- Seat cushion
- Steplessly inclinable backrest
- Fixed arm rest
- Foldable table and bottle holder
- Foot rest
- Magazine net

The seat frame is a welded steel pipe construction with weld-on flange plates for fixing the other seat components. The movement of the backrest is actuated by means of a gas spring fixed to the seat frame. The table board consists of a piece of cast aluminum. The table will be locked to the back rest by means of a turnable lock knob. The bottle holder consists of a bent steel wire. It has been welded on to the table bearing frame.
The footrest is adjustable in two positions:

1. Folded up, if the foot rest is not in use. In this case the space below the seat can be cleaned very easily
2. In the folded down position the rest is easily accessible for the passenger and offers a comfortable seating position.

NOTE

CONTENTS

CHAPTER 10

CHAPTER 10

WATER SUPPLY SYSTEM & TOILET

10.1 INTRODUCTION

LHB coaches have many state of the art features introduced in service first time on some of the premier trains on Indian Railways. One of the important features provided in these coaches is Control Discharge Toilet System (CDTS)

The basic purpose of introduction of CDTS is to eliminate the practice of spillage of toilet waste on to Railways station area & in the populated areas of city. The evacuation of toilet bowl is carried out by means of water pressure. It operates with a pressurized water bowl wash that covers 100% of the toilet bowl area. The waste is removed from the toilet bowl and transferred to a retention tank with minimum amount of water.

Salient Feature of Control Discharge Toilet System

- Low water and electrical consumption.
- P.L.C controlled (easily programmable)
- Less Environment pollution near stations area.
- Easy to clean.

Eco-Friendly Condition

- The controlled discharge toilet retains Human waste to avoid discharge at the stations. The system also provides a sealed commode with an efficient flushing system and provides odor free interior of toilets.

10.2 OPERATING PRINCIPLE OF CDTS

This system works on electrical & pneumatic pressure arrangement. The retention tank which stores effluent has two openings. These two openings activate by double acting pneumatic cylinders fed by feed pipe of air brake system. Upper opening opens every time the user operates the flush button, whereas lower opening opens at predetermined speed & after predetermined no. of cycle of flushes. The solenoid/ magnetic valves control the entry of air pressure in pneumatic cylinders.

The pressurizer provided in CDTS system, delivers pressurized water to flush the waste. The logical control records the no. of flush cycle as well as speed of the vehicle through WSP system to operate the lower opening to drain out the effluent.

The CDTS system starts working on a single push of flush button switch. As the flush button is pressed the flow of water starts into the toilet bowl and opens the slide/flapper valve connecting the toilet bowl to the waste retention tank. At the end of each flush cycle the wash water stops and the toilet is sealed off from the retention tank by the slide/flapper valve, which acts as an effective stench trap, preventing odor from entering the toilet room.

The waste accumulated in the retention tank remains in the retention tank until two parameters are satisfied -

1. A predetermined no. of flush counts have been recorded; and
2. The train has reached a minimum speed of 30 Kmph.

The retention tank discharge valve remains open only for a small period of time (one minute or less), long enough to empty the retention tank; then closes and remains closed until the above parameters are again satisfied.

The CDTS system is based on RDSO specification MDTS: 091. Most CDTS available on LHB coaches are of following makes-

(a) M/S Aikon Technologies Pvt. Ld.

(b) M/S Vibhu Composite Works.

10.3 BRIEF DETAILS

Toilet system has following components:-

1. Indian & European Toilet Basin with Flush Nozzles.

There are two types of toilet basin used in these CDTS system. This toilet basin made up of stainless steel AISI 304.

2. Control Panel

Control of CDTS consists of following equipments:-

- **Programmable Logic Controller (PLC)**

The programmable logic controller records the no. of flush cycles as well as speed of the vehicle through WSP system to control the flushing & opening/ closing of retention tank to drain out the effluent. PLC work on 24 V DC having 8 inputs & 4 outputs.

- **Solenoid Valve**

The solenoid valve control the entry of pneumatic air in the pneumatic cylinders fitted on the upper & lower slide valves based on the signals from PLC.

- **Control Relay**

Control relay is fitted aside of PLC on the control panel. A supply of 110 V DC is present in the control relay. This control relay operates at 24 V DC. When 24 V DC is received, control relay operates & the 110 VDC supply present in control relay is passed on to the water pressurize.

3. Retention Tank

The efficient drained from the toilet basin bowl after flushing is stored in the retention tank. In case of extra flush (beyond) the capacity of tank) over flow pipe is provided to drain out the efficient.

4. Upper Slide Valve/ Flapper Valve

Upper slide valve is opened with the operation of flush button**.** It closes after efficient enters the retention tank. This slide valve consists of a slide which is connected by means of link to two pneumatic cylinders. The slide valve open and closes by the movement of piston of pneumatic cylinder controlled by PLC & solenoid valves. The movement of slide is horizontal as per design. In the latest version, the flapper arrangement has been introduced instead of upper slide valves, to overcome slide-jamming problems. This flapper arrangement consists of a flap, which is connected by means of connecting links to the pneumatic cylinder on charging of pressure in the pneumatic cylinder.

5. Lower Slide Valve

This slide valve consists of a slide which is connected by means of link to two pneumatic cylinders. The slide valve open & close by the movement of piston of pneumatic cylinders controlled by PLC & solenoid valves.

6. Flush Button

This is an electrical switch. On pressing this switch the electric circuits are completed with the PLC & flush cycle starts.

7. Water Pressurizer

Water pressurizer is fitted in the inlet of water pipe line connection of the CDTS system. As the flush button is operated this water pressurizer is started & pressurized water is supplied to the toilet basin.



8 Fail Safe Mode

A "FAIL SAFE MODE" of operation has also been provided. In the event of a loss of air, electricity, or both; to enable use of the toilet, "FAIL SAFE MODE" is provided.

- In case of loss of air and/or electricity, the retention tank upper slide valve will automatically revert to the open position, and remain in the open position until air and electricity are restored.
- In case of gradual drop of air or power, the upper slide valve automatically opens and remains opened, till air and power supply are restored.
- A push button style water bypass valve is provided in the toilet to provide minimum amount of water to the toilet in emergency situation. Water will flow into the toilet bowl as long as Push Button on the water by pass valve is depressed. When the push button is released, the flow of water will automatically stop. (This valve is marked: No light – press to flush).

Certain features of the toilet flush style will be restricted in the "FAIL SAEF MODE" but the toilet will remain functional.

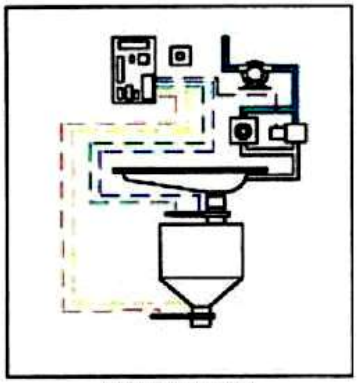
NOTE: *Fail Safe Mode of operation has been provided only for an emergency and should not be used during normal conditions.*

I Operational Description

i) Stand-by Condition

The status of various components/devices is listed below:

- Water Pressurizer – Off
- Water check Valve – Closed
- Retention Tank Inlet Valve – Closed
- Retention Tank Discharge Valve – Closed



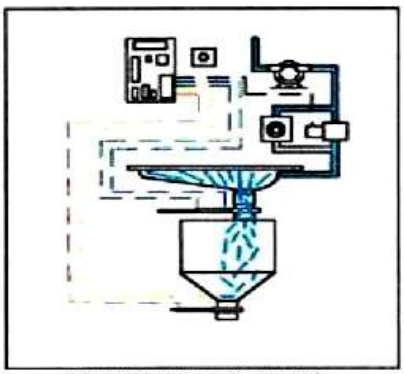
TOILET AT REST

ii) Flush Cycle

Depress momentarily Flush Button. The status of various components/devices is listed below:

Step – 1

- Water Pressurizer – On (for a predetermined
- Water Valve – On (for a predetermined time)
- Retention Tank Inlet Valve – Open (for a predetermined time)

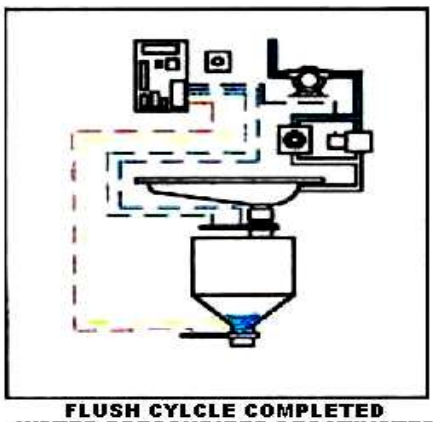


FLUSH CYCLE INTIATED
WATER PRESSURIZER ACTIVATED
TOILET DISCHARAG VALVE OPENS

Step – 2

- Water Pressurizer – Off
- Water check Valve – Off
- Retention Tank Inlet Valve – Closed

With above steps the Flush Cycle is Completed. (Stand-by Condition)



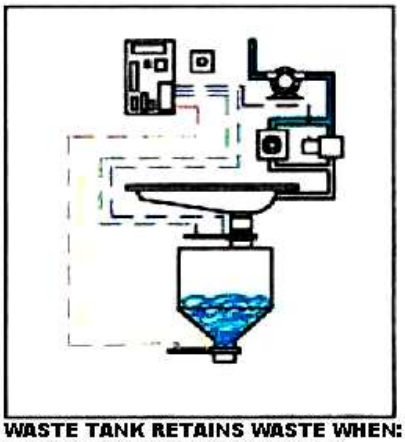
FLUSH CYLCLE COMPLETED
WATER PRESSURIZER DEACTIVATED
TOILET DISCHARGE VALVE CLOSES
TOILET WASTE RETAINED IN WASTE TANK

iii) Retention Tank Discharge Cycle

The status of various components/devices is listed below:

a) Condition – I

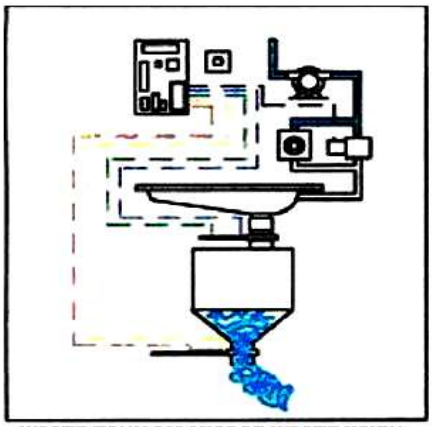
If train speed is - below 30 kmph then the retention tank discharge slide valve – closed



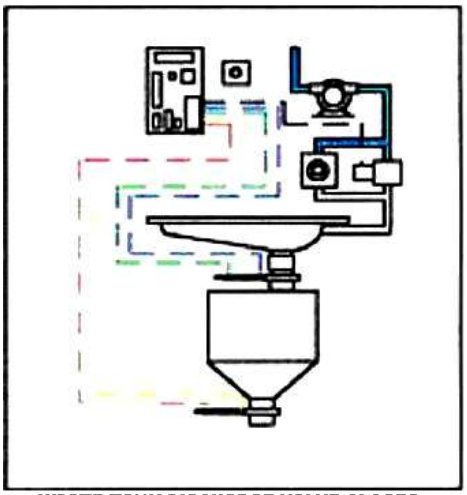
WASTE TANK RETAINS WASTE WHEN:
1. TRAIN SPEED BELOW 30 Kmph
2. FLUSH COUNT BELOW PROGRAMME FLUSH CYCLE

b) Condition – II

- If train speed is above 30 kmph and Flush Count is below predetermined value, then the Retention tank lower slide valve remain closed.
- If the train is above 30km/h and Flush Count is equal or above programmed number (say 3 or 4), the retention tank lower slide valve will open (for a predetermined time).
- End of retention tank discharge cycle.
- Flush count restarts at zero (0).
- Train speed continues to be monitored by the logic controller
- If the train decelerates to 30kmph or below, the retention tank lower slide valve opens, regardless of flush count (for a predetermined time)



WASTE TANK DISCHARGE WASTE WHEN:
1. TRAIN SPEED IS ABOVE 30 Kmph
2. MORE THAN PROGRAMMED FLUSH CYCLE HAVE SEEN ERCORDED



WASTE TANK DISCHARGE VALVE CLOSES
WASTE TANK EMPTY
TRAIN SPEED MONITORING RESET
FLUSH COUNT MONITORING RESET

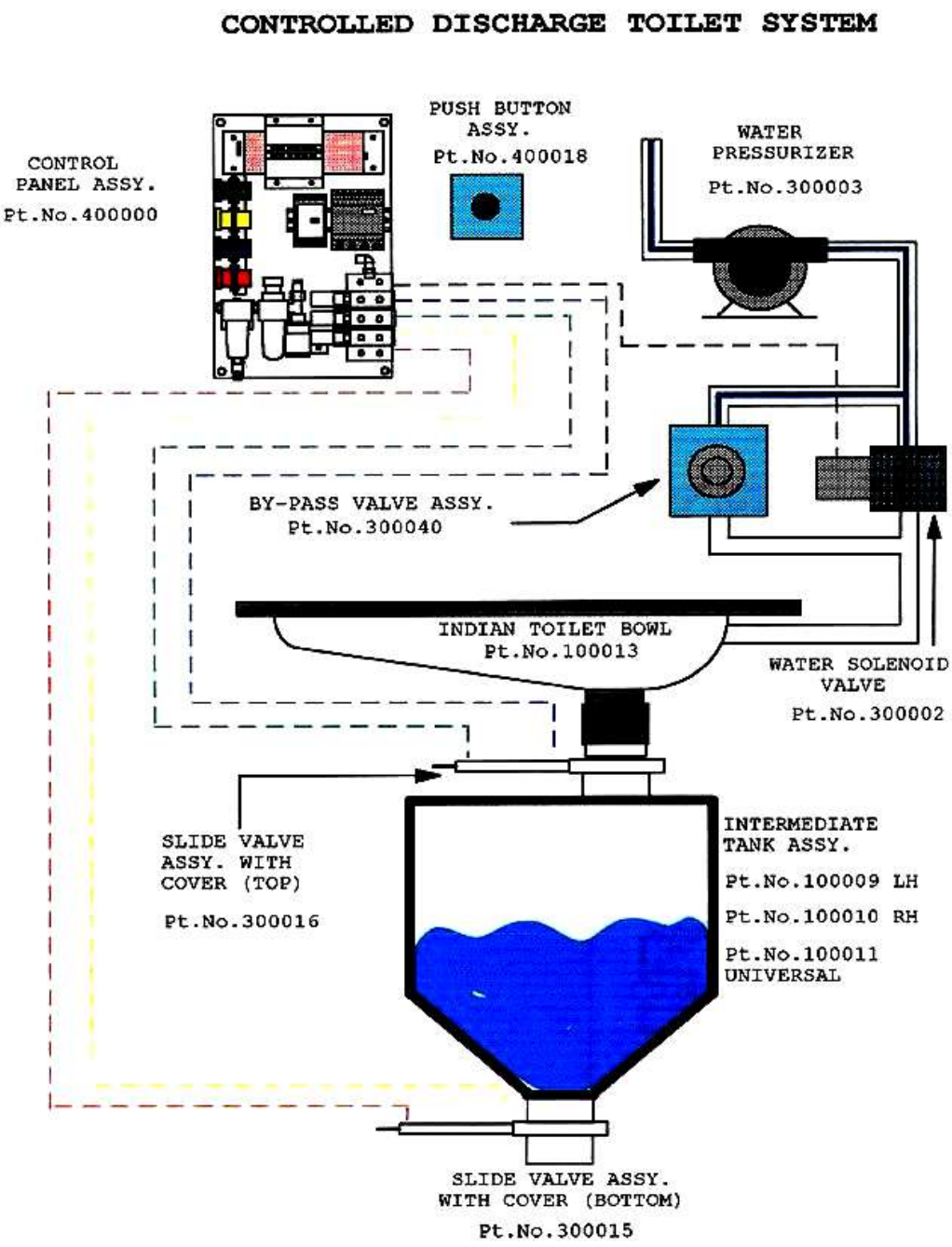


Fig: 10.1 Schematic diagram of CDTS

II Control Panel Wiring Diagram

Control Panel of CDTS has various electrical / electronic, pneumatic components inter- linked through various color-coded wiring. For wiring diagrams of three and two spool valve configuration, please refer to OEM‟s manual of respective makes.

CDTS and WSP Interface Wiring Instructions

When installing or changing the CDTS, electrical control panel, it must be determined which WSP unit is provided on the coach

The WSP unit supplied by SAB Wabco must be wired to output “Q3” of the logic controller on the CDTS electrical control panel.

NOTE: The SAB Wabco unit supplies a normally open contact below 30 kmph and closes above 30 kmph.

The WSP unit supplied by Knorr Bremse must be wired to output “Q4” of the logic controller on the CDTS electrical control panel.

NOTE: Tthe knorr bremse unit supplies a normally closed contact below 30 Kmph and opens above 30 Kmph

All CDTS electrical control panels supplied from the factory will be pre-wired into output “Q3”, which is compatible to SAB Wabco.
To change the control panel to be compatible to Knorr Bremse, simply remove the wires at “Q3” and reinstall the wires into output “Q4”.
Layout of PLC with eight input/output terminals is shown below.

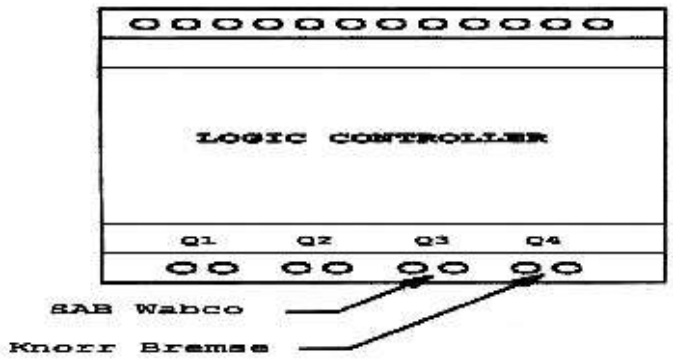


Fig: 10.2 CDTS and WSP interface wring instructions

Note: -Whenever a repair is attempted on Control Panel, ease Ensure 24 V DC Inlet supply to Control Panel. Higher current shall damage the equipment

III Speed Sensing Device

The speed-sensing device works on the principle of induced E.M.F. The device does not require any attention during its service. However due to use of sensitive magnetic elements the whole unit may require replacement in the following cases.

1. The electronic unit is damaged due to excessive current in the vicinity.
2. Very high temperatures are applied close to the unit during welding operations.
3. Due to Accidents damaging the Sensing Unit.

The sealed unit must be removed from the axle end in case of major attentions, warranting welding or heating for any other purpose.

i) Mounting of Speed Sensor

Extreme precaution is to be taken to integrate the speed sensor with the axle box cover. In case new unit is required to be fitted, the following procedure should be followed -

1) Break open the sealing wire
2) Open the four bolts
3) Remove the complete unit
4) Check condition of special sensing bolt, if necessary
5) Reassemble

V Push Button Replacement

To repair or replace the push button the FRP panel inside the toilet room must be removed.

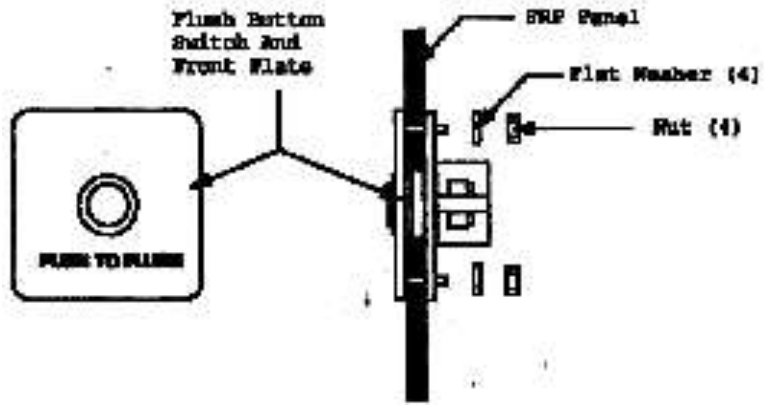


Fig: 10.3 Push Button Replacements

To remove the flush button, remove the four nuts and flat washers securing the flush button back plate to the FRP panel. Remove the back plate. Remove the flush button assembly through the front of the FRP panel. Reinstall in the reverse order.

10.4 MAINTENANCE

Solenoid Valves	• The solenoid valve can be checked by pushing the button present on Y1, Y2&Y3 valves. • The solenoid valve operates at 5 bar pressure. • It needs filtered compressed air for long time working. • If it is not working simply open it and after cleaning its spool by a soft cloth reinstall it at its position.   
Air Filter	• Air filter should be cleaned when water appears. • Air Filter can be opened, cleaned & can be fitted. • Avoid any impact on Air Filter that may crack the air filter.
Pressurizer	• The spring inside the pressurizer should be fitted properly. • The pressurizer can be opened by opening the side nuts and can be properly cleaned. • Tighting of nuts & bolts should be checked regularly. • The pressurizer should be properly fitted at define position.  
Flush Nozzle	• The flush nozzle should be cleaned regularly with toilet brush & soap water.  

Flapper Valve (Inlet)	• The Flapper valve should be cleaned with soap water once in a month. • The speed controller should be properly adjusted • The nuts should be tightened properly • The Rubber sheet gasket should be suitable placed on flapper 
Slide Valve (Outlet)	• The Slide valve should be cleaned with soap water once in a month. • The nuts should be tightened properly • The gasket should be suitably placed at grooves.   
Controller (PLC)	• The P.L.C. should be fitted properly at control panel plate, not to be loose fitted. • Check signals on PLC whether it is green for O.K. and red for not O.K. • Avoid any impact or shock on P.L.C. that may damage it. 

10.4.1 On Board Defects and Trouble Shooting

PROBLEM	CAUSES	REMEDY
No Flush Water	• Valve Y3 on the control panel is defective or non-operational	Activate valve Y3 on the control panel manually
	• The control panel fails to transmit signals (the red light is not illuminated)	Check the electric signals and connections
	• An air hose may be bent	Check the air hoses (activate Y3 manually)
	• The shut-off cock on the water tank is closed	Open the cock
	• No water in the tank	Fill the tank
Flapper valve not open during flushing.	• The inlet valve fails to open.	Activate the push button "Inlet" on the control panel
	• Valve Y2 on the control panel is defective or non-operational.	Activate valve Y2 on the control panel manually.
	• The controller (PLC) fails to transmit signals	Check the electrical signals and connections.
	• An air hose may be bent	Check the air hoses (activate Y2 manually)
The outlet valve fails to open	• The outlet valve fails to open.	Activate the push button "outlet" on the control panel
	• Valve Y1 on the control panel is defective or non-operational.	Activate valve Y1 on the control panel manually.
	• The controller (PLC) fails to transmit signals	Check the electrical signals and connections.
	• An air hose may be bent	Check the air hoses (activate Y1 manually)
No activity by the Pressurizer	• The ball valve of Pressurizer closed	Open the ball valve
	• There is a failure signals in the controller.	Check the electric signals and connections
	• Valve Y3 on the control panel is defective or non operational.	Activate valve Y3 on the control panel manually

PROBLEM	CAUSES	REMEDY
The Toilet Basin is not Evacuated.	• There is a blockage in the pipe between the basin and the retention tank.	Open the inlet valve by operating the push button on the control panel & push or press the blockage into the retention tank.
	• The inlet valve fails to open.	Activate the push button "inlet" on the control panel.
	• Valve Y3 on the control panel is defective or non operational.	Activate valve Y3 manually.
	• The control panel fails to transmit signal.	Check the electric signals & connections.
	• An air hose may be bent.	Check the air hoses (operate Y3 manually).
	• The retention tank is full due to blockage.	Open the outlet valve by activating the push button on the control panel. Remove the blockage by flushing or washing out the blockage from inside the toilet compartment.
		Activate the push button " outlet" on the control panel.
	• The outlet valve fails to open.	Activate valve Y2 manually.
	• Valve Y2 on the control panel is defective or non operational.	Check the electric signals and connections.
	• The controller fails to transmit signals.	Check the air hoses (activate Y2 manually)
	• An air hose may be bent.	
No Activity by Operation of the Flush Button	• The flush button is defective	Disconnect the power supply & replace the flush button.
Continuous Water Falling From Nozzles	• Some foreign particles in water can obstruct the flush valve operation.	Remove the flush valve and clean it with a soft cloth and again put it into the line.

PROBLEM	CAUSES	REMEDY
The flush water constantly runs in the basin.	• Dirt keeps the slide valve or valve Y1 open. • The slide valve is defective. • Valve Y1 on the control panel is open. • Valve Y1 is defective.	Clean the valve. Replace slide the valve. Activate valve Y1 manually. Replace the valve.
Slide Valve not Working	• There is a blockage due to foreign material like cup, napkin, tissue paper etc.	• Operate the inlet valve by Y3 manually. • Clean it with soap water or • Check pipes from solenoid valve & lock pipes of loose. • Check pipe from solenoid valve & lock pipes if lose.
Outlet (Lower) Valve Open at Maintenance Pit Line	• Wires from speed sensor are not properly connected. • Pipes from solenoid valve are loose. • WC is not working	Check connectivity between point 4 & 6 in terminal block. Check fittings of pipes, lock the pipe if loose. Check WC wired from power panel

10.5 PERIODIC MAINTENANCE SCHEDULES

Sr. No.	Description	Schedule D-1	Schedule D-2	Schedule D-3
	Frequency of Examination -------►	**Trip/ Weekly**	**Monthly**	**Half Yearly**
1.	Clean toilet thoroughly and flush out.	√	√	√
2.	Check working of Solenoid Valves. If found jammed attend by cleaning. If problem still persists then replace valve.	√	√	√
3.	Check working of all Slide Valves. If found jammed attend the problem. If problem still persists, then replace.	√	√	√
4.	Check PU pipes for proper fitment/ leakages.	√	√	√
5.	Check pneumatic lines for loose connection, leakages or damages.	√	√	√
6.	Check water line plumbing for any leakage/ damages and attend as necessary.	√	√	√
7.	Check WC push button for crack/damage. Replace/ repair as necessary.	√	√	√
8.	Check continuity of speed sensor to control panel.	√	√	√
9.	Check Timer Switch of wash Basin & other taps for proper functioning.	√	√	√
10.	Check water pressurizer for proper working. De-scale if found scaled.	√	√	√
11.	Check working of PLC. Replace if necessary.	√	√	√
12.	Check sliding valves for any leakages. If found leaking then replace the „O" Rings.	√	√	√
13.	Open slide valve cover box and check following: • Slide valve seal for water leakage. • Check front and rear nuts of slide valve for looseness. • Check alignment of air cylinders and slide valve spindles. • Check Flapper valves.	---	√	√
14.	Check air filter for condensate deposit. If water is accumulated, adjust drain plug or replace air filter.	---	√	√
15.	Check oil level of Air Lubricator. Replenish recommended oil if oil level is low.	---	√	√
16.	Clean screen of water strainer.	---	√	√
17.	Check and tighten mounting bolts on retention tank.	---	√	√

Sr. No.	Description	Schedule D-1	Schedule D-2	Schedule D-3
	Frequency of Examination ------►	**Trip/ Weekly**	**Monthly**	**Half Yearly**
18.	Clean control panel, and attend for any loose contacts.	---	√	√
19.	Check Pressure Switch operation, reset if necessary.	---	√	√
20.	Remove By-pass valve for cleaning, Replace if necessary.	---	√	√

10.5.1 Attention during Shop Schedules

The CDTS system and its components should be given complete overhaul during Shop Schedules (SS –I, SS –II and SS – III). For details of overhauling, please refer to OEM‟s instructions.

Note: For any further details please refer to RDSO Spec. No. C-9906 Rev.-3 of Mar‟2009 i.e. „Schedules of Technical Requirement of CDTS for Indian Railway (Coaches).

10.6 WATER SUPPLY SYSTEM

For water supply system and instruction for filling water in LHB coaches, kindly refer to RDSO Pamphlets No. C- 7601 & C- 9009 respectively**.**

10.6.1 Types of water tanks:

1st type :

Volume of water contained :		685 liters
Dimensions :	Length :	2760 mm
Diameter :		591 mm
Material :		Stainless steel

The tanks are installed in twos, are fixed with frames and are secured by safety belts.

The tanks must contain only water.

The 685-liter-tanks installed in the under frame constitute the fresh water reserves in the passenger coaches.

2nd type :

Volume of water contained :		450 liters
Dimensions :	Length :	2037 mm
Diameter :		591 mm
Material :		Stainless steel

The tanks are installed alone, are fixed with frames and are secured by safety belts.
The tanks must contain only water.

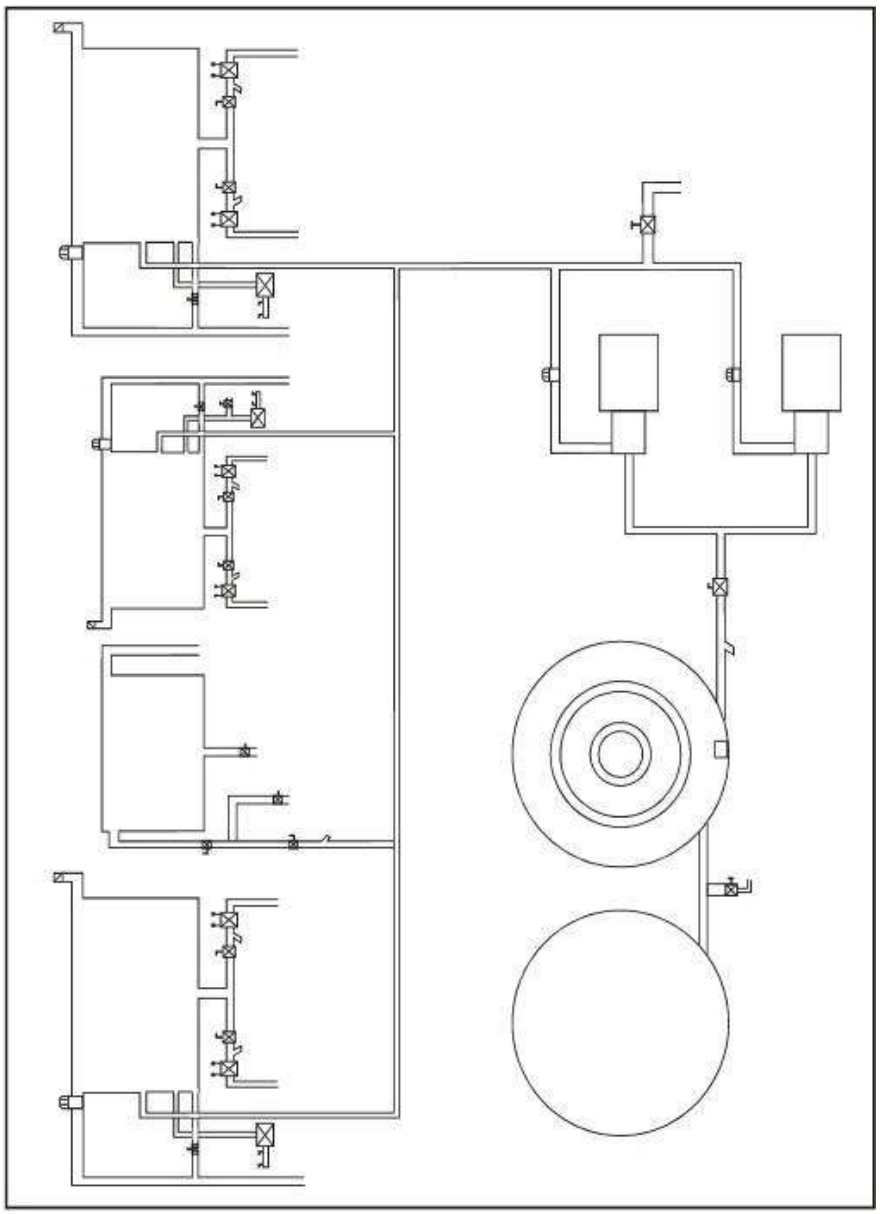
The 450-liter-tanks installed in the under frame constitute the fresh water reserves in the generator cars.

3rd type :

Volume of water contained :		30 liters
Dimensions :	Length :	927 mm
Diameter :		220 mm
Material :		Stainless steel

The tanks are installed alone and are fixed with 2 supports which are equipped with belts. The tanks must contain only water. The 30-liter tanks are installed in the roof and are continuously freshwater-fed by means of pumps. They maintain the good running of water supply of the barometrical capacitor at each station, thanks to their exposed positioning. The tanks are complete and welded as well as the support frames. The elastic joints (glued) of the frames and the waterproof ness joints of the flanges are mounted. The screws and bolts of the tanks are installed. Only the screws and bolts of the frames are separately delivered.

In case of necessary repairing, references of glued joints and of glue are provided.



Layout of Water Supply System

10.6.2 Cleaning Of the Water System of the LHB Coaches with Vinegar to Wash Out Chalk Deposit

Due to the quality of the water with a high hardness used in service for the LHB coaches a regular cleaning of the water system with vinegar is required to avoid the negative effect of lime scale on the function of the water system.

It is advisable to execute the cleaning at three levels:

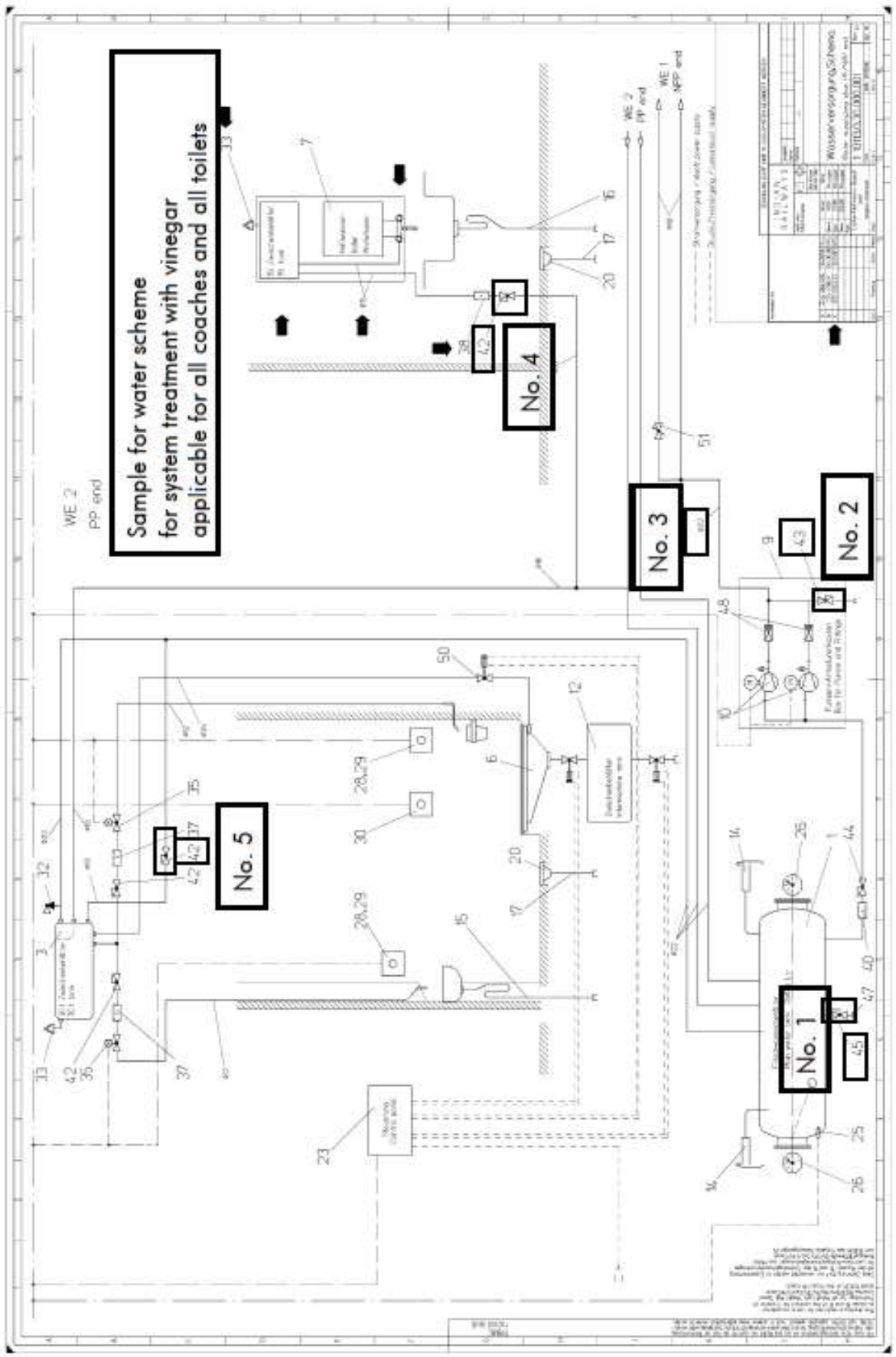
Type	**Name**	**Time intervall**
Level -1	Rinsing of the water pumps	every 4 weeks, but latest all 8 weeks
Level -2	Rinsing of the pipes	every 3 months
Level -3	Rinsing of the system	every 6 months

The following work steps have to be executed on the different levels:

Type	**Description**
Level - 1	**Rinsing of the water pumps:** - **drain off the water from the 685 Ltr. tanks through the valve on the tank bottom (water scheme, pos. 45, No. 1) except for 100 Ltr. per tank** - fill 4 Ltr. vinegar in each tank. - open the draining for both pumps (water scheme, pos. 43, No. 2). - drain off 10 Ltr. from each pump and close the draining. - loosen the pipe for water supply behind the pump container (water scheme, pipe with diameter 22 mm, No. 3). - start fist pump and let 20 Ltr. out, switch pump off. - start second pump and let 20 Ltr. out, switch pump off. - wait for min 6 hours (max 10 hours). - drain off the water from the 685 Ltr. tanks (water scheme, pos. 45, No. 1). - open the draining for both pumps (water scheme, pos. 43, No. 2). - drain off water from each pump and close the draining again. - fill each 685 Ltr. tank with 100 l each. - rinse both pumps alternating. - drain off the water from the 685 Ltr. tanks (water scheme, pos. 45, No. 1). - fix the pipe for water supply behind the pump container (water scheme, pipe with diameter 22 mm, No. 3). - fill the system with water.

Type	Description
Level -2	**Rinsing of the pipes** - **close valve for water supply for pantry (below wash basin) (water scheme, pos. 42, No. 4)** - **drain off the water from the 685 Ltr.tanks through the valve on the tank bottom (water scheme, pos. 45, No. 1) except for 200 Ltr. per tank** - fill 6 Ltr. vinegar in each tank - open the return valve above the control panel for each of the 3 water tanks for the toilets (water scheme, pos. 42, No, 5) - start pump and rinse for an hour - drain off the water from the 685 Ltr. tanks through the valve on the tank bottom (water scheme, pos. 45, No. 1) - fill 400 Ltr. in each tank - start pump and rinse for an hour - **drain off the water from the 685 l tanks through the valve on the tank bottom (water scheme, pos. 45, No. 1)** - close the return valve above the control panel for each of the 3 water tanks for the toilets (water scheme, pos. 42, No, 5) - fill system with water - **open valve for water supply for pantry (below wash basin) (water scheme, pos. 42, No. 4)**
Level - 3	**Rinsing of system** - **close valve for water supply for pantry (below wash basin) (water scheme, pos. 42, No. 4)** - **drain off the water from the 685 Ltr. tanks through the valve on the tank bottom (water scheme, pos. 45, No. 1) except for 150 l per tank** - fill 10 Ltr. vinegar in each tank - open the return valve above the control panel for each of the 3 water tanks for the toilets (water scheme, pos. 42, No, 5) - **start pump and rinse for 30 minutes** - close the return valve above the control panel for each of the 3 water tanks for the toilets (water scheme, pos. 42, No. 5) - **use WC flush, wash basin flush and mug flush 3-times each** - **wait for 24 hours** - **drain off all water from the tank above toilets (water scheme, pos. 42, No. 5)** - **drain off all water 685 l tanks (water scheme, pos. 45, No. 1) and pumps (water scheme, pos. 43, No. 2)** - fill the 685 Ltr. tanks - start the pump and rinse for 10 minutes

Type	Description
	- **use WC flush, wash basin flush and mug flush 3-times each** - **drain off all water from the tank above toilets (water scheme, pos. 42, No. 5)** - **drain off all water 685 Ltr. tanks (water scheme, pos. 45, No. 1) and pumps (water scheme, pos. 43, No. 2)** - fill system with water - **open valve for water supply for pantry (below wash basin) (water scheme, pos. 42, No. 4)**


Sample for water scheme
for system treatment with vinegar
applicable for all coaches and all toilets
WE 2
PP end
WE 1
NPP end
No. 1
No. 2
No. 3
No. 4
No. 5

NOTE

CHAPTER 11

MAINTENANCE SCHEDULES (ELECTRICAL)

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CHAPTER 11

ELECTRICAL MAINTENANCE SCHEDULES

11.0 INTRODUCTION

The LHB design of AC coaches is quite different from ICF design AC coaches. The maintenance practices for these coaches are also different. The various maintenance schedules and their periodicity are mentioned below:

Periodic Maintenance Schedules

- Schedule D1 : Trip / Weekly
- Schedule D2 : Three monthly ± 3days
- Schedule D3 : Half Yearly ± 15 days
- Shop Schedule (SS-1), IOH : 18 Months / 6 Lakh kms whichever is earlier
- Shop Schedule (SS-2), POH : 36 Months / 12 Lakh kms whichever is earlier

The EOG, LHB rake mainly comprises of AC coaches, power cars and pantry cars. The electrical equipment of this rake have been described in chapters 6, 7 and 8 of this manual. The equipment wise maintenance activities of above schedules and work instructions for SS-1 and SS-2 are described in this chapter.

11.1 ROOF MOUNTED AC PACKAGE UNIT

As per RDSO"s Maintenance Schedule No. RDSO/PE/SMI/AC/0044-2011 (Rev.0) dated 02/04.11.2011, following maintenance activities to be carried out on roof mounted AC package unit of LHB design coaches:

11.1.1 General

Activities		TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Check the log sheet maintained in each AC coach and attained the defects recorded by escorting staff during run.	✓	✓	✓	✓	✓
b.	Clean all dust by vacuum cleaner or by compressed air from the switch board cabinet and tighten the cable terminals, if found loose.	--	✓	✓	✓	✓
c.	Replace/ connect defective/ by passed components.	✓	✓	✓	✓	✓
d.	Cleaning of air grills	-	-	-	✓	✓

	Activities	TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
e.	i) Remove return air filters by opening the access doors of the unit. Clean these filters with vacuum cleaner or by compressed air after taking out the filters and place them gently in their places or replace with pre-cleaned/ new filter/ filter media and close the doors properly. A cleaning jig should be available with AMC holders/ Railways for this activity. **Note:** After this activity, the service doors shall be latched properly in case of return air filter. Similarly, the fresh air grill shall be positioned and locked properly.	✓	✓	✓	To be replaced	To be replaced
	ii) Remove fresh air filters by opening the access doors of the unit. Clean these filters with vacuum cleaner or by compressed air after taking out the filters and place them gently in their places or replace with pre-cleaned/ new filter/ filter media and close the doors properly. A cleaning jig should be available with AMC holders/ Railways for this activity.	--	✓	✓	---	---
f.	Check looseness of microprocessor‟s input/ output connections.	---	---	✓	✓	✓
g.	Check that the microprocessor controller is firmly mounted.	✓	✓	✓	✓	✓
h.	Check analogue type pressure gauges for their working provided on switch board panel.	✓	✓	✓	✓	✓
i.	Check working of rotary switches by rotating forward and backward, provided on switch board panel for temperature selection and air control ON. Replace if required.	✓	✓	✓	✓	✓
j.	Check working of set point generator rotary switch provided for temperature setting.	✓	✓	✓	✓	✓
k.	Check the tripping of heaters i.e. OHP. The OHP setting is 65°C. The testing of OHP setting shall be done by switching off the blower. During testing, the probe of digital thermometer shall be placed near the sensor of OHP & the display shall be kept outside. **Note** : It shall be checked twice a year. In addition, it shall also be checked as a pre-winter precaution before the onset of winter season.	--	--	✓	✓	✓

Activities		TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
l.	Check whether ESTI cartridge is provided with bulb and properly screwed. Note : It shall be checked twice a year, in addition, it shall also be checked as a pre-winter precaution before the onset of winter season.	--	--	✓	✓	✓
m.	Run the plant for half an hour and then check the current drawn by various equipment with the help of clamp tester (tongue tester) duly calibrated. Normal currents for various equipments and mode of operation are as under: ▪ Package unit in cooling mode - 20-23 Amps ▪ Compressor - 7.5 – 9.5Amps. ▪ Condenser fan motor - 1.5 – 2.1 Amps. ▪ Blower motor - 1.5-2.5 Amps ▪ Package unit in heating mode -07-11 Amps Note: The current also depends on the ambient temperature.	✓	✓	✓	✓	✓
n.	Check visually roof & condenser fan blade and ensure that there is no crack on the blade or hub.	--	✓	✓	✓	✓
o.	Check and tighten mountings of blower, compressor and blower motors and ensure that they are in good condition.	--	--	✓	✓	✓
p.	Ensure that no capillary tubes are in hanging position.	--	✓	✓	✓	✓
q.	Check capillary tubes provided for HP/LP cutout for proper support/ clamping. Their nuts should be properly tightened.	--	✓	✓	✓	✓
r.	Capillary type HP/LP cut out should be replaced with HP/LP cutout without capillary during IOH/POH. HP/LP cut out and its sensors should be replaced in SS-4 schedule i.e. after 72 months.	--	---	--	✓	✓
s.	Check for proper tightening of cover provided over evaporator compartment.	--	✓	✓	✓	✓
t.	Check that earthing shunts in RMPU are provided. Earthing shunts should be earthed with coach body.	--	--	✓	✓	To be replaced
u.	Check canvas duct provided at return & supply air. Rectify or replace the same, if torn or damaged.	--	--	✓	To be replaced	To be replaced
v.	Run the plant in conjunction with micro-processor controller and observe for any abnormality.	✓	✓	✓	✓	✓

Activities		TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
w.	Check anti-vibration mountings of compressors, condenser motors, blower motor and over all package unit. Replace if required.	--	--	✓	✓	AVM for over all package unit to be replaced
x.	If less cooling is noticed, check the leakage of refrigerant from the system by using soap solution or leak detector. If leak is detected, it should be attended and re-charging of refrigerant in the system shall be made as per RDSO"s SMI ELPS/AC/SMI/14.	✓	--	✓	✓	✓
y.	Check insulation resistance of all the motors & compressors by the duly calibrated 1000V megger. Attend the motors, if insulation resistance of motor is found less than 2M ohm. Important: Disconnect microprocessor controller during this activity.	--	--	--	✓	✓
z.	Check for physically damaged/ jointed cables. Replace if needed.	--	✓	--	✓	✓
z-i	Check for the physically damaged conduits. Replace them, if needed.	--	✓	--	✓	To be replaced
z-ii	Check for proper working of servo drive.	--	--	✓	✓	✓
z-iii	Harting connector to be replaced	--	--	--	✓	✓

11.1.2 Refrigerant Pipe Line/ Capillary

Activities		TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Check for proper clamping/ support.	--	--	--	✓	✓
b.	Check for rubbing of capillary with SS sheet/ channel or other parts of RMPU.	--	--	--	✓	✓
c.	Check leakage from flare nut of HP/ LP cutouts with soap solution.	--	--	---	✓	✓
d.	Check leakage from feeler tube of OHP.	--	--	--	✓	✓

11.1.3 Compressors

Activities		TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Check and ensure holding clamps from top are properly tightened.	--	--	✓	✓	✓
b.	Check and ensure mounting fastenings are properly tightened.	--	--	✓	✓	✓
c.	Check leakage from suction & discharge port.	--	--	✓	✓	✓
d.	Check Accumulator holding/ mounting, if provided.	--	--	✓	✓	✓

Activities		TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
e.	Ensure condensing area covers are properly tightened & not touching top of compressor body.	--	--	✓	✓	✓
f.	Check electrical terminal box is properly tightened & cables are terminated with lugs.	--	--	✓	✓	✓

11.1.4 Condenser Fans Motor/ Blades and Blower Motor/ Impeller

Activities		TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Check and ensure mounting fasteners are properly tightened.	--	--	✓	✓	✓
b.	Check electrical terminal box of motors is properly tightened & cables are terminated with lugs.	--	--	✓	✓	✓
c.	Ensure double earthing shunts are provided.	--	--	---	✓	To be replaced during POH
d.	Check condition of blade for its fixing/ cracking/ breakage/ damage or touching with its cover. Rectify/ replace, if needed.	--	--	✓	✓	✓
e.	Ensure proper clamping of cable conduits.	--	--	✓	✓	✓
f.	Overhauling of Blower and condenser fan motors shall includes the following during POH. ▪ The incoming motors shall be checked for abnormal noise and vibration. ▪ Check bearing make and replace with specified make, if found defective. ▪ The IR value of motor stator shall be measured between motor terminal and frame before and after overhauling. The value of IR shall not be less than 10 MΩ, when measured with 1000 volt megger. ▪ Winding resistance of motors shall be measured between RY, YB & BR phases. The winding resistance shall be ± 10% of resistance declared by OEM in cold condition. ▪ Check closely terminal block and connecting lead for any physical damage or any flash mark over it. Replace the same, if not satisfactory.	--	--	--	--	✓

	Activities	TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
	▪ Perform HV (Di-electric test) on stator by applying 1.5 kV AC supply for one minute. During test the leakage current shall also be measured, which shall not be more than 1.0 mA. ▪ Run motor on no load for 15 minutes and check the following. i. Bearing noise – Normal noise. ii. Bearing temperature rise above ambient should not be more than 10°C. iii. SPM reading – 20dB max. (Green zone) ▪ Measure starting current of motors on no load. It shall not be more than 10 times of normal running current. Similarly, the running current of motors shall be measured and it shall not be more than 1.4A. ▪ Spray water over running motor by jet having 10mm dia from all side. After spray, check IR value. There should be no drop in IR value. ▪ Ensure the continuity of TOP. ▪ Anti tracking varnish					
g.	Ensure that impellers are properly tightened.	--	--	---	✓	✓
h.	Ensure electrical terminal box is properly tightened & cables are terminated with lug.	--	--	---	✓	✓

11.1.5 Return/ Fresh Air Filters

	Activities	TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Ensure that filters are not damaged.	✓	✓	✓	✓	✓
b.	Ensure that there is a provision to avoid wrong fitment in the filter as well as in RMPU.	--	--	--	✓	✓
c.	Filter media to be replaced	---	---	✓	--	---
d.	Complete filter shall be replaced	--	--	--	✓	✓

11.1.6 HP/ LP/ OHP Cutout Switch

Activities		TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Check that the mounting fasteners are properly tightened.	--	--	✓	✓	✓
b.	Ensure proper clamping/ support of capillary tube connected to HP/ LP/ OHP cutout switch.	--	--	✓	✓	✓
c.	Ensure that flare nuts are properly tightened.	--	--	✓	✓	✓
d.	Ensure that control wires to HP/ LP/ OHP cutout switches are properly clamped.	--	--	✓	✓	✓
e.	Ensure that covers of these HP/ LP/ OHP cutout switch are properly screwed.	---	✓	✓	✓	✓
f.	Ensure proper clamping of feeler tube of OHP switch.	--	--	--	✓	✓
g.	Remove the accumulated dust over feeler tube of OHP switch.	--	--	✓	✓	✓

11.1.7 Heater

Activities		TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Ensure proper mounting of heater.	--	--	✓	✓	✓
b.	Ensure proper clamping of electrical wires to heater.	--	--	✓	✓	✓
c.	Check dust accumulation on heating element. Remove gently, if required.	--	--	✓	✓	✓

11.1.8 NTC sensors

Activities		TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Ensure that the sensors provided at return air path, fresh air and supply air are firmly mounted.	--	--	✓	✓	✓
b.	Ensure sensor wires are properly clamped.	--	--	✓	✓	✓
c.	Remove the dust accumulated over sensor gently.	--	--	✓	✓	✓

11.1.9 Expansion Valve/ Capillary Tubes

	Activities	TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Ensure that the bulb is mounted in the suction line just after evaporator coil and in a position corresponding to between 1 O"clock and 4 O" clock. Ensure that it is properly insulated.	--	---	✓	✓	✓
b.	Ensure that the equalizing line is connected in the suction line immediately after the bulb.	--	--	✓	✓	✓
c.	Ensure that the bulb is not connected at the bottom of the pipe line.	--	--	✓	✓	✓
d.	Ensure that bulb/ equalizing line/ capillary tubes are not chocked.	--	---	✓	✓	✓
e.	Capillary tubes /expansion valve and HP/LP/CP cut out to be replaced **on condition basis**	--	--	--	--	✓ *****

*** on condition basis**

11.1.10 Evaporator Coil

	Activities	TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Ensure that there is no damage to fins.	--	--	--	✓	✓
b.	Ensure that capillaries of distributors to evaporator coil are not having any sharp bend or kinks. They should also be clamped properly.	--	--	--	✓	✓
c.	Ensure that air passes only through evaporator coils and no air is bypassed directly to blower chamber.	--	--	--	✓	✓
d.	Clean the coil, if found dirty. (i) cleaning through blower in D2. (ii) Cleaning through water jet in D3.	--	✓	✓	✓	✓
e.	Check that the mounting fasteners are properly tightened.	--	--	--	✓	✓

11.1.11 Filter Drier & Sight Glass

	Activities	TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Ensure that drier is installed with flow in the direction of the arrow marked on the filter drier label.	--	--	--	✓	✓
	NOTE : 1. Never use "Antifreeze liquids" like methyl alcohol together with a filter drier. Such liquid can damage the filter. 2. Never re-use a filter drier. 3. To avoid chances of moisture ingress in the system, filter drier & compressor should be installed immediately after evacuation and charging the system.					

11.1.12 Access Doors

	Activities	TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Insulate service doors, lower portion and side wall from inside of the evaporator compartment.	--	--	--	✓	✓
b.	Ensure that the latches to lock the service doors are not defective/ damaged.	✓	✓	✓	✓	✓
c.	Check and replace thermal insulation	--	--	--	✓	✓

11.1.13 Drip Tray

	Activities	TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Ensure that there is no leakage of condensate water from drip tray to electrical box & blower housing area.	--	--	✓	✓	✓
b.	Ensure free flow of condensate water.	--	✓	✓	✓	✓
c.	Roof of coach should be checked for Rain water leakage thoroughly, especially above electrical panels.	--	--	--	--	✓

11.1.14 Condenser Area

	Activities	TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Clean the condenser coil from inside with compressed air/ water jet after opening the cover of condenser area.	--	✓	✓	✓	✓
b.	Ensure that there is no damage to fins.	--	--	✓	✓	✓
c.	Check that the mounting fasteners are properly tightened.	--	--	--	✓	✓
d.	Provide fire retardant thermal insulation over suction line.	--	--	--	---	✓
e.	Ensure that there is no damage/ crack in structure frame of RMPU.	--	--	--	✓	✓
f.	Ensure proper clamping of electrical conduit.	--	--	--	✓	✓

11.1.15 Microprocessor Controller

	Activities	TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Check control logic of microprocessor controller on simulating kit.	--	--	--	--	✓

11.2 INTERNAL FITTINGS

	Activities	TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Check visually for any damages.	✓	✓	✓	✓	✓
b.	Check lights and emergency light system for proper functioning and replace defective lights.	✓	✓	✓	✓	✓

	Activities	TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
c.	Check and clean lamp shades/ covers	--	✓	✓	✓	✓
d.	Replace broken diffusers, reflectors, defective invertors and holders	--	--	✓	✓	✓
e.	All shortages are to be replenished	--	--	✓	✓	✓

11.3 BATTERY

	Activities	TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Check visually battery boxes and suspension for any damage or irregularity	✓	✓	✓	✓	✓
b.	Check container and inter-cell connections and clean, if necessary.	--	✓	✓	✓	✓
c.	Check battery connections for tightness	--	--	✓	✓	✓
d.	Clean battery connections and apply petroleum jelly or Vaseline	--	--	✓	✓	✓
e.	Remove the batteries from battery boxes.	--	--	--	✓	✓
f.	Clean and repair battery boxes and repaint with anti corrosive epoxy based paint.	--	--	--	✓	✓
g.	Clean thoroughly corrosion/ sulphation of inter-cell connectors etc. and protect them from further corrosion by applying petroleum jelly or vase-line. Change cell connectors and fasteners on condition basis.	--	--	--	✓	✓
h.	Record lug date to determine the life of the battery	--	--	--	✓	✓
i.	Charge the battery fully till 3 constant hourly readings of voltage indicates the conditions of a fully charged cell.	--	--	--	✓	✓
j.	Tighten the safety vent plugs if found loose.	--	--	--	✓	✓
	Carry out the capacity test ▪ Charge the battery fully till 3 constant hourly readings of voltage indicates the condition of a fully charged cell. ▪ Discharge the battery at 10 hours discharge rate. While discharging, record the voltage. ▪ Record the capacity of the battery during discharge. It should not be less than 80% of the rated capacity.	--	--	--	--	✓
k.	In case while discharging, any of the cell"s voltage falls below 1.75 V within 08 hours disconnect the cell from the circuit for treatment with 01 or 02 cycles of slow charge & discharge as per manufacturers maintenance manual.	--	--	--	--	✓
l.	After 2 cycles of charge & discharge, recharge the cells fully.	--	--	--	--	✓

11.4 BATTERY CHARGER

Activities		TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Open the cover of battery charger and clean with soft brush & vacuum cleaner	--	--	--	✓	✓
b.	Check the loose connection and overheating marks and take corrective action.	--	--	--	✓	✓
c.	Take IR of live terminals to body. It should be more than as specified in Table- 11.1.	--	--	--	✓	✓
d.	Replace sealing gasket	--	--	--	--	✓

11.5 STEP DOWN TRANSFORMER 60 kVA

Activities		TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Open the cover and clean with compressed air/ vacuum cleaner.	--	--	--	✓	✓
b.	Check loose connection, overheating marks and take corrective action.	--	✓	✓	✓	✓
c.	Take IR of live terminals to body. It should be more than as specified in Table- 11.1.	--	--	--	✓	✓
d.	Ensure proper clamping of cable conduits.	--	--	--	✓	✓
e.	Check tightness of suspension arrangement.	--	--	--	✓	✓
f.	Check sealing gasket.	--	--	--	--	✓
g.	Check grommets of all cable-entry holes.	--	--	--	--	✓
h.	Check and replace mounting bolts with grade of 10.9 (high tensile)	--	--	--	--	✓
i.	Check/replace AVM	--	--	--	--	✓

11.6 LIGHTING TRANSFORMER 1 kVA

Activities		TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Check the loose connection, overheating marks and take corrective action.	--	--	--	✓	✓
b.	Take IR of live terminals to body. It should be more than as specified in Table- 11.1.	--	--	--	✓	✓

11.7 SWITCH BOARD CABINET

Activities		TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Clean the panel with blower and vacuum cleaner and check for any loose connections.	--	✓	✓	✓	✓
b.	Ensure all cable entry holes are provided with grommets	--	--	--	✓	✓
c.	Check the contacts of power contactors and other contactors.	--	--	--	✓	✓
d.	Check the connection of switchgear terminals blocks for overheating and tightness.	--	--	--	✓	✓
e.	Check the fixation and terminal connections of microcontroller.	--	--	--	✓	✓
f.	Check rotary switch for proper working.	--	--	--	✓	✓
g.	Check all the earthing shunts and replace, if required.	--	--	--	✓	✓
h.	Check the working of gauges, voltmeters and ammeters.	--	--	--	✓	✓
i.	Take IR of live terminals to body for power and control supply. It should be more than as specified in **Table- 11.1**	--	--	--	✓	✓
j.	Check cabinet doors for proper closing and locking.	✓	✓	✓	✓	✓
k.	Check the door locks and hinges also.	✓	✓	✓	✓	✓
l	Replace MCBs for pantry equipment, pumps & Compressor on condition basis	--	--	--	--	✓
m	Check condition of contracts by measuring the contact area, mili volt drop etc.. Replace them on condition basis if fails in test.	--	--	--	--	✓
n	Replace disconnecting & earthing device complete rotary switch.	--	--	--	--	✓
o	Replace open type control fuse unit for HT circuit with fuse base holder assembly unit.	--	--	--	--	✓
p	Ensure provision of fuse/MCB safety protection in DC to DC convertor circuit	--	--	--	--	✓
q	Ensure working of MMRs (750Volts & 415Volts) & their replacement with new ones	--	--	--	--	✓
r	Replace defective MVRs.	--	--	--	--	✓
s	Replace contactors for compressors & K-44.	--	--	--	--	✓
t	Replace defective/ bypassed electronic module for contactors.	--	--	--	--	✓

u	Replace all defective/bypassed Microprocessor with latest universal type Microprocessor with adopter/ connectors.	--	--	--	--	✓

11.8 MISCELLANEOUS EQUIPMENT

Activities		TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
Main fuses						
a.	Check the availability of proper rating main fuses.	--	✓	✓	✓	✓
b.	Replace if fuse is blown/ missing.	✓	✓	✓	✓	✓
c	Replace old positive and negative fuse box at under frame	--	--	--	--	✓
Feeder cable						
a.	Check the condition and IR of feeder cable. It should be more than as specified in **Table-11.1**.	--	--	--	✓	✓
b.	Check proper clamping arrangement	--	--	--	✓	✓
c.	Check the connecting terminals for marks of over heating etc.	--	--	--	✓	✓
Water supply system						
a.	Check functioning of water pumping arrangement in test mode/pump controller if provided.	✓	✓	✓	✓	✓
b.	Replace old Monoblock pump with new one.	--	--	--	---	✓
c.	Visual check the mounting arrangement	---	---	---	✓	✓
Lavatory equipment						
a.	Check and ensure working of lavatory exhaust fans.	--	--	--	✓	✓
b.	Ensure cleaning and availability of sealing of covers/grills.	--	--	--	✓	--
c.	Cleaning the impellers of the exhaust items	--	--	--	--	✓
d	Replace old defective Lavatory light fitting with SS body antirust type light fitting.	--	--	--	--	✓
e	Replace old saving razor socket.	--	--	--	--	✓
Under frame						
a.	Check under slung electrical equipment, cables, and connections for external damages.	✓	✓	✓	✓	✓

Inter vehicle electrical power couplers						
a.	Check HT power jumper cables for external damage and over heating. Repair if required.	---	---	✓	✓	✓
b.	Check I.V. couplers for proper mating with thermo vision device.	--	---	--	✓	✓
c.	Check the condition of pins.	--	--	--	✓	✓
d.	Replace loosely crimped pins.	--	--	--	---	✓
e.	Check the locking arrangement & ensure its proper locking.	--	--	✓	✓	✓
f.	Take IR of live terminals to body. It should be more than as specified in **Table- 11.1**	--	--	--	✓	✓
Earthing						
a.	Check function of insulation monitoring device by creating single earth fault in supply lines.	--	---	✓	✓	✓
b.	Check condition of disconnecting and earthing switch. Replace if require in SS-2	--	--	--	✓	✓
c.	Check tightness of all the earthing connections.	--	--	--	✓	✓
d.	Measuring monitoring relay (MMR) to be calibrated on the test bench.	--	--	--	--	✓

11.9 MAIN PANTRY ITEMS

Activities		**TI (D1)**	**M (D2)**	**HY (D3)**	**IOH (SS-1)**	**POH (SS-2)**
a.	Check for damages and deficiencies in the pantry equipment and fittings and repair if required.	✓	✓	✓	✓	✓
b.	Check functioning of geyser, soup boiler, hot case & freezer.	✓	✓	✓	✓	✓
c.	Check water supply and drainage of pantry area.	✓	✓	✓	✓	✓
d.	Check the working condition of all the equipments.	✓	✓	✓	✓	✓
e.	Clean all the pantry equipments thoroughly.	--	--	--	✓	✓
f.	Check availability of locks, covers etc.	---	✓	✓	✓	✓
g.	Check earthing of each equipment.	--	--	--	✓	✓
h.	Check working of thermostats. Replace if found defective.	--	--	--	✓	✓

Activities		TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
i.	Check working of electric chimney	✓	✓	✓	✓	✓
j.	replace the filter of electric chimney.	--	--	✓	✓	✓
j.	Check the working of boilers.	✓	✓	✓	✓	✓
k.	Clean the boilers for removing scaling etc.	--	✓	--	✓	✓
l.	Check the heating element of boilers and replace if required.	--	--	--	✓	✓
m.	Check the working of indication lamps.	--	--	--	✓	✓
n.	Check for any leakage.	--	--	--	✓	✓
o.	Check the working of deep freezer, bottle cooler, hot case and OTG.	✓	✓	✓	✓	✓
p.	Check working/cooling of refrigerator. Measure the current of compressor of refrigerator.	✓	✓	✓	✓	✓
q.	Check starting capacitor value with LCR meter. If value is low, replace it.	--	--	--	✓	✓
r.	Check the working of starting relay for compressors.	--	--	--	✓	✓
s.	Clean the condenser of refrigerator and deep freezer.	--	--	--	✓	✓
t.	Check the insulation resistance of live terminals to body. It should be more than as specified in **Table- 11.1**.	--	--	--	✓	✓
u.	Exhaust fans	--	--	--	✓	✓
v	Replace all 3 pin sockets with 2 pole MCBs of proper rating.	--	--	--	--	✓
w	Replace dented/pitted doors of Deep freezer.	--	--	--	--	✓
x	Replace all old hot water boiler /geysers with new one.	--	--	--	--	✓
y	Replace complete Heater assembly with new one.	--	--	--	--	✓
z	Replace dented/pitted doors of Hot cases.	--	--	--	--	✓

11.10 MINI PANTRY ITEMS (DEEP FREEZER, BOTTLE COOLER, HOT CASE)

Activities		TI (D1)	M (D2)	HY (D3)	IOH (SS-1)	POH (SS-2)
a.	Check working of all mini-pantry equipment.	✓	--	--	✓	✓
b.	Clean all the pantry equipments thoroughly.	--	--	--	✓	✓
c.	Check and record current drawn by compressors for bottle cooler & deep freezer.	--	--	--	✓	✓
d.	Clean the condenser of refrigerator and deep freezer.	--	--	--	✓	✓
e.	Check starting capacitor value with LCR meter. If value is low, replace it.	--	--	--	✓	✓
f.	Check the working of starting relay for compressors.	--	--	--	✓	✓
g.	Check the working of boilers.	✓	--	--	✓	✓
h.	Clean the boilers for removing scaling etc	--	--	--	✓	✓
i.	Check working of thermostats of boilers.	--	✓	--	✓	✓
j.	Check the heating element of boilers and replace if required.	--	✓	--	✓	✓
k.	Check for any leakage.	--	--	--	✓	✓
l.	Check the working of hot case and its thermostats.	✓	--	--	✓	✓
m.	Check the working of indication lamps.	--	--	--	✓	✓
n.	Check the insulation resistance of live terminals to body. It should be more than as specified in **Table- 11.1**.	--	--	--	✓	✓
o.	Check earthling of each equipment.	--	--	--	✓	✓
p.	Replenish the item if found deficient.	--	--	--	✓	✓
q	Replace dented/pitted doors of Deep freezer.	--	--	--	--	✓
r	Replace all old hot water boiler /geysers with new one.	--	--	--	--	✓
s	Replace complete Heater assembly with new one.	--	--	--	--	✓
t	Replace dented/pitted doors of Hot cases.	--	--	--	--	✓

Table- 11.1

Sr. No.	Circuit Voltage	Capacity of Megger used	Min. value of IR required
1.	750V	1000V	05 M ohms
2.	415V	500V	03 M ohms
3.	230V	500V	02 M ohms
4.	190V	500V	02 M ohms
5.	110V	500V	02 M ohms
6.	24V	100V	01 M ohms

11.11 WORK INSTRUCTIONS FOR SHOP SCHEDULE SS-1

11.11.1 Pre-Inspection

- Place the coach on the pit line and inspect the electrical and air conditioning equipments.
- Conduct the pre-cooling test as per **Annexure '11.2'**.
- If the cooling time is less than the specified values, regular maintenance/ overhauling of air conditioning equipments is to be carried out.
- If cooling time is more than the specified values, complete air-conditioning system including supply air duct, coach sealing etc. needs to be checked.
- Down load the failure data of RMPU from Microprocessor controller for analysis and attention.
- Check operation of all the lights, pantry equipments, exhausts fans, WRA, battery charger, protections etc. and note down the defects and deficiencies.

11.11.2 Dusting

Remove dust of the conditioned supply air duct with the help of compressed air/ vacuum cleaner.

11.11.3 Final Testing

After installation of all the electrical equipments on the coach all the electrical equipments shall be checked and tested as per **Annexure 11.1.**

The following procedure shall be followed for different tests on air-conditioning system:

1. Air Delivery Test

- Conduct air delivery test after checking air leakage in the complete air-conditioning system.
- Calculate the total air delivery for any coach from the fundamental requirement of the „FRESH AIR REQUIRED PER PERSON" depending upon the type of coach.

- Minimum fresh air required for per person for AC coach is 0.35 m^3/ min.
- Measure fresh, return and exhaust air velocities with the help of anemometer using suitable hoods to avoid turbulence of air.
- Compute the volume of air by multiplying the velocity with face area.
- For ideal condition, the exhaust air should be equal to fresh air or it can be less by 10% but no reasons it should not be more than fresh air.

2. Pre-cooling Test

This test shall be conducted to record the time taken for cooling the coach without passenger, with fresh air filters closed, lights switched „ON" and after raising the inside temperature of air-conditioned compartment to 45°C.

Procedure:

1. Place the coach inside the shed.
2. Close all fresh air intake openings.
3. Record dry and wet bulbs temperature of ambient air.
4. A sample calculation for finding out compensating heat load for AC chair car is given at **Annexure 11.4.**
5. Calculate the electrical compensating heat load from the graph chart as per sample calculation given in **Annexure 11.4**
6. Provide the electrical compensating load, as calculated above, inside the coach. This load should be kept in OFF condition till further instruction.
7. Raise the inside temperature of the coach to 45°C by switching „ON" heater circuit in test mode.
8. Switch „ON" all lights. Set the temperature setting at position no. 6^{th} (i.e. 24.04°C) of both sides and run both the AC package units in auto mode keeping compensating load „OFF".
9. Record the timings for „cut off" of both the plants and other parameters during the test as per **Annexure 11.2**.
10. Total time taken by each plant to cool the coach should not exceed one hour.
11. Feeder testing on 750 volt.
12. Testing of local mains supply system.
13. Measurement of currents for AC plant.

11.11.4 Final Joint Inspection

Workshop supervisor with divisional supervisor shall jointly inspect the coach and the performance of electrical and refrigeration equipments shall be recorded as per Proforma at **Annexure 11.6**.

A details of equipments changed with new assemblies will also be handed over along with the coach to the divisional representative. Any attention, if required to the equipments shall be given before dispatch of the coach from workshop to division.

11.12 WORK INSTRUCTIONS FOR SHOP SCHEDULE SS-2

11.12.1 Pre-Inspection

- Carry out activities as given under SS-I.

11.12.2 Dusting

Remove the dust from conditioned supply air duct by compressed air / vacuum cleaner.

11.12.3 Striping

Remove the following air conditioning and electrical equipments for overhauling:

- Roof Mounted AC package units
- Water raising apparatus.
- Battery and battery Charger.
- Light fittings.
- Exhaust fans
- Pantry equipments.

Before overhauling, measure the insulation resistance of all the electrical equipments to know the condition of equipments.

11.12.4 Equipping

1. Fit all the refrigeration and electrical equipments to its respective locations.
2. Connect all the electrical wirings, air supply ducts in the air-conditioning unit (RMPU) and other electrical systems wherever required.

11.12.5 Final Testing

After installation of all the electrical equipments on the coach shall be checked and tested as per **Annexure 11.3**.

The following procedures shall be followed for different tests on air conditioning system.

1 Air delivery test

- Carry out test as given under SS-I.

2 Pre-cooling test

- Carry out test as given under SS-I.

3 Pull down test

Pull down test is conducted to see that AC plant is capable of cooling the coach in extreme summer condition when the coach is fully occupied.

Procedure:

1. Adjust all fresh air openings as per the requirement of the coach.
2. Switch „ON" the electrical compensating load.
3. Raise the compartment temperature to 45 º C by switching „ON" heater circuit in test mode.

4. Set the thermostat setting on both AC control panel at position 6 (i.e. 24.04°C). Switch „ON" all lights and fans.
5. Run both AC package units as soon as compartment temperature is raised to 45 ºC and record the time.
6. Record timings of „cut off" of each AC plant. It should not exceed 2 hours.
7. Electrical compensating heat load may be reduced (if testing persons are required to be present inside the coach) 120 W per person inside the conditioned space. (Proforma for recording pull down test is given in **Annexure 11.5**).

11.12.6 Final Joint Inspection

- As given under SS-I.

Maintenance of Generator cum Brake Van

For the maintenance of diesel generator set and its equipment follow the maintenance instructions of OEM.

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11.13 TROUBLE SHOOTING OF LHB TYPE EOG COACH

11.13.1 Details of Input & Output Connections of AC Compact Controller

Pin No.	LED No.	Name	From cable No.	To Terminal No.	To cable No.	From/To
X-301 (Digital Output Unit-I)						
1	-	OC	610101.01	125, 124	610101.03	From MCB (F-35) to Output +ve common
2	01	Controller OK	610408.01	165	610408.02	For contactor K-27
3	02	Recirculation Air	610115.01	145	610115.02	From NC contact of K-21 through cable no. 610116 to contactor K-22
4	03	Ventilation Fan-1	610403.01	311	610403.02	From TOP of Vent-1 through cable no. 610404.01 to terminal 164, cable no. 610404.02 to contactor K-26
5	04	This pin is not in use				
6	05	Bypass cooling 1.1	610603.01	178	610603.02	To bypass solenoid valve U1Y3
X-302 (Digital Output Unit-I)						
1	-	OC	610101.06	125, 124	610101.03	From MCB (F-35) to Output +ve common
2	06	Condenser Fan 1.1	610601.01	176	610601.02	For contactor K-31
3	07	Condenser Fan 1.2	610602.01	177	610602.02	For contactor K-32
4	08	Compr 1.1	610605.01	180	610605.02	From HP cutout of Compr 1.1 through cable no. 610604.01 to terminal no. 181 to cable no. 610604.02 to contactor K-33
5	09	Compr 1.2	610608.01	183	610608.02	From HP cutout of Compr 1.2 through cable no. 610607.01 to terminal no. 184 to cable no. 610607.02 to contactor K-34
6	10	Heater 1	610610.01	186	610610.02	To contactor K-35
X-701 (Digital Input Unit-I)						
1	11	Air condition ON	610401.03	153	610401.02	From Air condition ON/OFF rotary U4S1
2	12	Temperature Condenser motor 1.1 OK	610407.02	156	610407.01	From TOP of condenser motor 1.1
3	13	Temperature Condenser motor 1.2 OK	610409.02	157	610409.01	From TOP of condenser motor 1.2

Pin No.	LED No.	Name	From cable No.	To Terminal No.	To cable No.	From/To
4	14	Vent motor-1	610405.02	154	610405.01	From NC contact of contactor K-26
5	15	Temperature Heater-1 OK	610410.02	158	610410.01	From OHP, Heater-1
6	-	IC	610102.05	127, 126	610102.03	From MCB (F-35) to Input -ve common
7	16	Low Pressure 1.1 OK	610412.02	159	610412.01	From LP cutout 1.1
8	17	Low Pressure 1.2 OK	610414.02	160	610414.01	From LP cutout 1.2
9	18	Control Pressure 1	610415.02	161	610415.01	From Control Pressure Cutout Condenser 1.1 or Control Pressure Cutout Condenser 1.2
10	19	HP 1.1 Fault	610606.01	182	610606.02	From HP Cutout Comp 1.1
11	110	HP 1.2 Fault	610609.01	185	610609.02	From HP Cutout Comp 1.2
12	-	IC	610102.04	127, 126	610102.03	From MCB (F-35) to Input -ve common
X-501 (Digital Output Unit-2)						
6	-	OC	610101.07	125, 124	610101.03	From MCB (F-35) to Output +ve common
5	011	Fault	610125.01	148	610125.02	For Fault Lamp U4H1
4	012	Fresh Air	610110.01	144	610110.02	From NC contact of K-22 through cable no. 610111 to contactor K-21
3	013	Ventilation Fan-2	610411.01	312	610411.02	From TOP of Vent-2 through cable no. 610413.01 to terminal 167, cable no. 610413.02 to contactor K-28
2	014	Exhaust Fan	610416.01	313	610416.02	For contactor K-29
1	015	Bypass cooling 1.2	610703.01	179	610703.02	For bypass solenoid valve U2Y3
X-502 (Digital Output Unit-2)						
6	-	OC	610101.04	125, 124	610101.03	From MCB (F-35) to Output +ve common
5	016	Condenser Fan 2.1	610701.01	187	610701.02	For contactor K-36
4	017	Condenser Fan 2.2	610702.01	188	610702.02	For contactor K-37
3	018	Compr 2.1	610705.01	191	610705.02	From HP cutout of Compr 2.1 through cable no. 610704.01 to terminal no. 192 to cable no. 610704.02 to contactor K-38

Pin No.	LED No.	Name	From cable No.	To Terminal No.	To cable No.	From/To
2	019	Compr 2.2	610708.01	194	610708.02	From HP cutout of Compr 2.2 through cable no. 610707.01 to terminal no. 196 to cable no. 610707.02 to contactor K-39
1	020	Heater 2	610710.01	197	610710.02	For contactor K-40
X-702 (Digital Input Unit-2)						
11	111	400V OK	610124.02	140	610124.01	From NO contact of contactor K-23
10	112	Temperature condenser motor 2.1 OK	610501.02	170	610501.01	From TOP of condenser motor 2.1
9	113	Temperature condenser motor 2.2 OK	610502.02	171	610502.01	From TOP of condenser motor 2.2
8	114	Vent motor-2 Fault	610406.02	155	610406.01	From NC contact of K-28
7	115	Temperature Heater-2 OK	610503.02	172	610503.01	From OHP of Heater-2
6	-	IC	610102.06	127, 126	610102.03	From MCB (F-35) to Input -ve common
5	116	Low pressure 2.1 OK	610504.02	173	610504.01	From LP cutout 2.1
4	117	Low Pressure 2.2 OK	610505.02	174	610505.01	From LP cutout 2.2
3	118	Control Pressure 2	610506.02	175	610506.01	From control pressure cut out Condenser 2.1 or Condenser 2.2
2	119	High Pressure 2.1 Fault	610706.01	193	610706.02	From HP cutout compr 2.1
1	120	High Pressure 2.2 Fault	610706.01	195	610709.02	From HP cutout compr 2.2

11.13.2 Air Conditioning Unit not Working

In case of non working of following equipment of AC unit, check 415V AC, three phase supply at the Contactors, MCBs & terminals of the respective equipment.

Equipment	MCB No.	Contactor No.	Terminal No.
Ventilation fan-1	1	K-26	231, 232, 233
Ventilation fan-2	2	K-28	235, 236, 237
Condenser Motor CD-1.1	6	K-31	253, 254, 255
Condenser Motor CD-1.2	7	K-32	256, 257, 258
Compressor 1.1	3	K-33	239, 240, 241
Compressor 1.2	5	K-34	243, 244, 245

Equipment	MCB No.	Contactor No.	Terminal No.
Heater (HTR)-1	8	K-35	247, 248, 249
Condenser Motor CD-2.1	12	K-36	273, 274, 275
Condenser Motor CD-2.2	13	K-37	276, 277, 278
Compressor 2.1	9	K-38	259, 260, 261
Compressor 2.2	11	K-39	263, 264, 265
Heater (HTR)-2	14	K-40	267, 268, 269

Check following after switching ON AC control MCB S1F35

1 Ensure glowing of 400V OK (11) AC ON indication at CPU. If indication is glowing, then check 415V AC in the panel. If 415V AC is proper in the panel but the indication of 415V AC is not glowing in the CPU, then check relay S1K23. Replace if defective or bypass the contacts 33-34. Check fuse S1F73 before bypass. Replace the fuse if defective.

2 If the indication of Controller OK is not glowing in the CPU, then check relay S1K27. Replace if defective or bypass the contacts.

3 A Heater not working

i) Ensure proper working of Heater MCB & ON Heater Contactor K-35 & K-40.

ii) Keep temperature selection rotary at Maximum.

B If Heater Contactor is ON then note the following display at CPU:

i) LED 5 & 15 (Temperature of Heater OK) are glowing. If these are not glowing, it means heater is tripped from OHP. Ensure proper rotation & working of blower motor.

ii) Clean fresh air & return air filters.

C Loose duct air sensor connection

Check terminal block at the left side of control panel for terminal no. 136 & 137 for Unit-1 and terminal no. 138 & 139 for Unit-2. Tighten if loose.

D If the Heater contactor is ON & coach is not heating. Check current at the heater contactor. If current is not indicating at the contactor, it means heater is trip from EHTI. Switch OFF the MCB as the glass cartridge must have blown and it needs to be replaced.

E If both side heater units have trip from EHTI. Heating mode can not be operated. Switch OFF both MCBs and face the situation with common prudence.

4 If Ventilation fan, Condenser motor or compressor is trip from TOP, check for single phasing in the circuit between motor & MCB.

11.13.3 Coach Supply not Getting 'ON'

Safety: Isolator Earthing Equipment should be switched OFF by putting it to (O) OFF position before doing any work on line in the power panel

Check following in case of Coach is not getting „**ON'**

1. Check battery voltage at voltmeter. It should be 96V (Min).
2. Check voltmeter of Net-1 & Net-2. All three Voltmeters (L1, L2 & L3) of each net should indicate 750V.
3. If battery net is indicating 0 V, then check for blown DC main fuses (25A) F1 & F2. Replace if defective.
4. If battery net is indicating 96 V or less and coach is not getting ON, then extend the DC from adjoining coach in emergency. Care should be taken while connecting +ve & -ve terminals.
5. Check MCB SIF-33 and ensure 110VDC at the output. Replace if defective.

If coach is not getting ON after ensuring proper DC

a) Net 1 : Check fuse no. S1F50, S1F51, S1F52 (63A/80A HT)

Net 2 : Check fuse no. S1F53, S1F54, S1F55 (63A /80A HT)

b) Ensure all MCBs on Power Panel are in „ON" condition

6. Check power ON/OFF rotary switch. Replace if defective.
7. Ensure proper working of „NO" contacts of rotary switch for Net-1 & Net-2.
8. Check K-2 auxiliary „NC" contact for proper working, if Net-1 is not getting „ON".

9 Ensure „ON" of Phase Measuring & Monitoring relay. If not getting „ON", bypass contact no. 12 & 13.

10 Check K-1 auxiliary „NC" contact for proper working, if Net-2 is not getting „ON".

11 If contactor for Net 1 or Net 2 are „ON" but 415VAC supply is not available in the coach then:

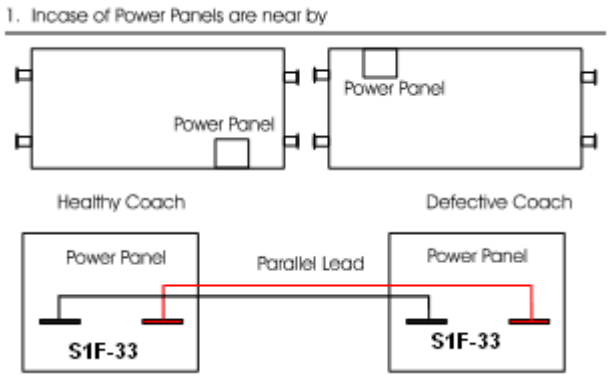
a) Check fuse no. S1F44, S1F45, S1F46 (100A) Replace if defective

b) If 415V contactor K-44 is not getting „ON", Check fuse No. S1F72 (1A) Replace if defective. Check „NC" contact 21 & 22 of K-43. Bypass if defective.

11.13.4 Non-functioning of Battery Charger

If battery charger is not working then check Input (32A) & Output (63A) fuses of battery charger. Ensure proper tightened connections of three leads at connector (If battery charger is defective extend 110V DC supply from adjoining coach).

Procedure for extending 110V DC from adjoining coach



1 The lead (cable) for paralleling (extending feed) the DC supply should be clearly marked for +ve & -ve. The cross section of cable should not be less then 6 mm^2 and the insulation should be proper. Damaged/jointed cable should not be used.

2 First connect the cable at the input side of S1F-33 MCB at defective coach. Due care should be taken for connecting +ve & -ve terminals.

3 Other end of the lead should be connected at the output side of S1F-33 MCB at Healthy coach. Due care should be taken for connecting +ve & -ve terminals.

4 DC will be available at defective coach and the coach can be switched ON.

11.13.5 Defect in Lighting System (Lights not getting ON)

1 Ensure input & output supply of Lighting Transformer.

2 If input supply of lighting transformer is missing then check fuse no. S1F74 & S1F75. Replace if defective.

3 Check 110V AC at output of MCB S1F39 & SIF 40.

4 Check MCB S1F30 for Lighting Control. Replace if defective (MVR).

5 If Lighting Contactors K-11 & K-14 are not ON, then ensure proper working of Power ON/OFF rotary switch and Push ON & Push OFF switches of Lighting.

6 If lights are not ON then bypass contact no. 15 & 18 of S1K17. If then also lights are not getting ON then bypass Lighting contactors S1K11 & S1K14.

Contactor for Night Light	S1K13
Contactor for Reading Light	S1K12
Contactor for Emergency Light	S1K15 & S1K16
Contactor for AC Light	S1K11 & S1K14

11.13.6 Frequent Tripping of Supply in Coach

1 Phase Monitoring Relay is not working properly

2 If Red LED indication at Phase Monitoring Relay Trip is glowing, bypass the contact 12 & 13.

3 Emergency Lights should work automatically during tripping of power supply in coach, if it is not working push Light ON switch & if the lights do not gets ON then check MCB no. 24, 25 & 26. Switch these MCB ON, if lights not work after this, then wedge the contactor K-12.

11.13.7 If AC Control MCB (F-35) Trips

1 Checking of –ve & +ve wire Earth Fault

i) Disconnect negative wire from AC control MCB (F-35) and ON the MCB, if the MCB trips, it indicates that there is +ve earth fault otherwise not.

ii) Disconnect positive wire from AC control MCB (F-35) and ON the MCB, if the MCB trips, it indicates that there is -ve earth fault otherwise not.

2 Positive wire Earth Fault

Disconnect negative wire from AC control MCB (F-35) and ON the MCB, if the MCB trips then disconnect cable no. 610101.08 from terminal no. 125 and switch ON the MCB, if it do not holds, then check for short circuit & earth fault in Microprocessor & in the coils and diodes fitted in the contactors of AC circuit.

Disconnect cable no. 610101.82 from terminal no. 125 and switch ON the MCB. If it holds then reconnect this cable at terminal 125 and disconnect cable 610101.12 from terminal 162 and if the MCB holds in this condition then bypass the CPU and run all motors and compressors through bypass.

Note: Heater should not be run in bypass condition. If it is done in emergency the coach should be under regular observation.

3 Negative wire Earth Fault

Disconnect positive wire from AC control MCB (F-35) and ON the MCB, if the MCB trips then disconnect cable no. 610102.07 from terminal no. 127 and switch ON the MCB, if it do not holds, then check for short circuit & earth fault in Microprocessor & in the coils and diodes fitted in the contactors of AC circuit.

If MCB holds after disconnecting cable no. 610102.07 from terminal no. 127, then reconnect it and disconnect cable no. 610102.18 from coil (A-2) of contactor for CD 1.2 (K-32). If then also the MCB trips then check the coils & diodes of contactor K-31, K-29, K-28, K-27, K-26 and replace the defective.

If the MCB holds after disconnecting cable no. 610102.18 from coil (A-2) of contactor for CD 1.2 (K-32), then reconnect the cable and disconnect cable no. 610102.19 from terminal 179 and if the MCB holds then switch OFF Unit-1.

If the MCB still trips after disconnecting cable no. 610102.19 from terminal 179 then reconnect it and disconnect cable no. 610102.26 from terminal 190 and if the MCB holds then switch OFF the Unit-2.

Extending 3 phase, 415VAC supply from adjoining coach

1 Switch OFF the Isolator Earthing Device of the defective coach by putting it to „O" position.

2 Connect one end of the 3½ core paralleling lead at the output terminals of Contactor K-44 of the defective coach. The connections should be made with care i.e R, Y, B & Neutral.

3 Switch OFF the Isolator Earthing Device of the Healthy coach by putting it to „O" position.

4 Connect one end of the 3½ core paralleling lead at the output terminals of Contactor K-44 of the healthy coach. The connections should be made with care i.e R, Y, B & Neutral.

5 Switch ON the Isolator Earthing Device of the Healthy coach. Don"t switch ON the Isolator Earthing Device of the defective coach.

6 Check the rotation of motors after switching ON supply in defective coach. Change the phase if rotation is not proper.

Keep the defective coach under observation

11.13.8 No Water in Coach

1 Empty water tank.

2 Check water pump contactor K-24 & K-25. One contactor should be in ON position.

3 Check Pump overload Relay F-21 & F-22 for trip. Black push should be in push condition for normal working.

4 If both pump contactors are OFF, check pump controller terminal 1 & 2. Ensure 24 V DC between terminal 1 & 2. If 24 VDC is not coming check pump control MCB F-20 for ON condition.

5 If 24 VDC is available at pump controller and the controller is not working bypass the controller by disconnecting cable no 32050504 from terminal no. 1 and connect it with cable no. 3308254 at terminal no 2 for operating pump-1 or at cable no. 3308253 at terminal no. 3 for operating pump-2.

6 If pump is working but water is not coming, remove air lock of the system or check for proper rotation of the pump.

11.14 TROUBLE SHOOTING OF LHB TYPE GENERATOR CAR

11.14.1 Engine not Starting

- Ensure 24VDC supply
- Magnetic switch not operating
- Self starter not working. Check the solenoid coil.
- Ensure supply at FSS or shut down valve.
- Check Emergency OFF switch at engine panel. It may be stuck in pushed condition.
- Check Emergency OFF switch near engine room door. It may be stuck in pushed condition. Reset it.

11.14.2 ACB not getting ON

- Ensure proper position of Plant Selector Switch.
- Switch ON S2 panel.
- Check K-20 relay and ensure it is ON.
- Check indication at UVR. Check 6A fuses 1, 2, 3 for Set-A & 12, 13, 14 for Set-B and ensure 415 VAC at these fuses. If these are OK and supply is available but the indication is still coming at UVR, disconnect cable no.1 AFR from NC point of UVR.

11.14.3 Feeder Contactor not getting ON

- Check fuse no. 9 (Set-A) and fuse no. 18 (Set-B). Replace if blown.
- Check Relay K-12 for Set-A & K-13 for Set-B. These should be ON.
- Check coil of feeder contactor.

11.14.4 Bus Coupler not getting ON

- Ensure proper position of Plant Selector Switch.
- Check fuse no. 8 (Set-A) and fuse no. 17 (Set-B). Replace if blown.
- Check Relay K-11 for Set-A & K-10 for Set-B. These should be ON.
- Check coil of Bus Coupler contactor.

11.14.5 Safety Loop not getting ON

- Check fuse no. 19 (Set-A) and fuse no. 20 (Set-B). Replace if blown.
- Check Relay K-15 & K-18. These should be ON.
- Check safety switches fitted with I.V.Coupler. Ensure proper working or bypass them.
- Check FEL & FOL1. Reset if indication is coming.
- If FEL indication is coming frequently. Check the rake for earth leakage.

11.14.6 Main Battery Charger not getting ON

- Check 100A fuses (44, 45, 46) & ensure supply at them.
- Check male sockets of battery charger for looseness. Ensure they are tight.
- Check battery charger incoming fuse.

11.14.7 Main Battery Charger ON but battery not charging

- Check fuse no. 1 (63A) +ve & -ve box in underframe.
- Check battery cell couplings and tighten if found loose.
- Check all cells and replace the defective battery set.

11.14.8 Emergency Battery Charger not switching ON in case of Main Battery Charger defective

- Check relay 24VDC inside charger. Wedge if not ON.

11.14.9 110V AC Lights not getting ON

- Check 10A fuses no. 74 & 75 in the incoming supply of lighting transformer
- Lighting transformer is of the rating 230/110V. Check incoming and output supply accordingly.
- Check K-48 interlocking relay. It should be ON.
- Check K-11 & K-14 relays. These should be ON.

11.14.10 Emergency Lights not getting ON

- Ensure 110VDC supply at voltmeter
- Check K-08 relay which is controlled by MVR. It should be ON.
- Check K-16 relay which is for Emergency Lights. It should be ON.

11.14.11 Transformer contactor not getting ON

A) For LHB Generator Car

- Ensure 110VDC at the voltmeter of S1 panel.
- ON the power supply MCB and check is it passing the supply
- Check DC/DC converter fitted on the contactor. Replace if defective.
- Check 1A fuses in PMR circuit (fuse no. 90, 91, 92 for Set-A and 94, 95, 96 for Set-B)
- Check Isolator Earthing Device. It should be ON.
- Switch On the Public Address System MCB.

B) For RCF built Generator Car

- Check DC/DC converter fitted on the contactor. Replace if defective.
- Check Push button. Replace if defective.
- Ensure availability of 110VDC supply.
- Switch ON the Power Supply MCB

11.14.12 415V Main contactor (K-44) not getting ON

- Check 2A fuse no. 72
- Check AC/DC converter
- Ensure neutral at AC/DC converter.

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Annexure 11.1

ELECTRICAL TEST REPORT FOR AC COACHES AFTER SS-I

Type of Coach---------- Coach No.----------

Date of testing---------- Railway----------

1.0 INSULATION RESISTANCE

Sr. No.	Circuit Voltage	Capacity of Megger used	Min. value of IR required	Actual value observed	Remarks
1.	750V	1000 V	05 M ohm		OK / Not OK
2.	415 V	500 V	03 M ohm		OK / Not OK
3.	230 V	500 V	02 M ohm		OK / Not OK
4.	190 V	500 V	02 M ohm		OK / Not OK
5.	110 V	500 V	02 M ohm		OK / Not OK
6.	24 V	100 V	01 M ohm		OK / Not OK

2.0 AIR CONDITIONING EQUIPMENTS

a) Electrical load test

Sr. No.	Description	Specified Load Current	Actual observed		
			R	Y	B
AC PLANT No. 01 (PP SIDE)					
1.	BLR	2.6 ± 10% Amp			
2.	CD1	2.1 ± 10% Amp			
3.	CD2	2.1 ± 10% Amp			
4.	CP1	8.25±25% Amp			
5.	CP2	8.25±25% Amp			
6.	HTR1	10 Amp			
7.	HTR2	10 Amp			
AC PLANT No. 02 (NPP SIDE)					
1.	BLR	2.6 ± 10% Amp			
2.	CD1	2.1 ± 10% Amp			
3.	CD2	2.1 ± 10% Amp			
4.	CP1	8.25±25% Amp			
5	CP2	8.25±25% Amp			
6.	HTR1	10 Amp			
7.	HTR2	10 Amp			
Load Current for RMPU					
Voltage for RMPU - 415 ± 10% V					
Total Power Consumption in kVA					
Total Power Consumption in kW					

b) Pre cooling test .....as per **Annexure '11.2'**

c) Air delivery test:

Sr. No.	Description	Specified	Actual observed	
			PP	**NPP**
1	Fresh Air (FA)	Air delivery-	12.69	12.39
2	Return Air (RA)	0.35 m^3/ min/ passenger	7.23	16.83
3	Exhaust Air (EA)	Approx. 3 x Fresh Air	0.50	4.63
4	Conditioned Air (CA)	Equal or less than 10% of FA	---	---
		Fresh Air + Return Air		
a) Total Fresh Air (PP+NPP)		= 20.08 Cub mtr/ min		
b) Total Return Air (PP+NPP)		= 49.85 Cub mtr/ min		
c) Total Exhaust Air (PP+NPP)		= 9.63 Cub mtr/ min		
d) Total Cond. Air (PP +NPP)		= 147.27 Cub mtr/ min		

3.0 WATER RAISING APPARATUS

Sr. No.	Description	Specified Load Current		Actual observed		
		M/s. Elgi	M/s Kalsi	R	Y	B
	WRA/ Mono Block Pumps	Amps.	Amps			
1.	1	1.2	1.1			
2.	2	1.2	1.1			

4.0 PANTRY EQUIPMENTS

a) **For Coaches**

1	Deep Freezer	OK / Not OK
2	Bottle Cooler	OK / Not OK
3	Hot Case	OK / Not OK

b) **For Hot Buffet**

1	Hot Case	OK / Not OK
2	Deep Freezer	OK / Not OK
3	Water boiler	OK / Not OK
4	Burners 1,2 & 3	OK / Not OK
5	Chimneys 1,2 & 3	OK / Not OK
6	Insect Killer	OK / Not OK
7	Fridge	OK / Not OK

5.0 LIGHTING CIRCUITS

1	Working of main lighting circuit	OK / Not OK
2	Working of emergency lighting circuit	OK / Not OK
3	Working of stand alone emergency light	OK / Not OK
4	Night Light	OK / Not OK
5	Berth Reading Light (in case 2T/ FAC)	OK / Not OK
6	Indication Lights	OK / Not OK

6.0 TESTING OF SWITCH BOARD CABINET

1	Battery Charger		OK / Not OK
2	Emergency Battery Charger		OK / Not OK
3	Exhaust Fans		OK / Not OK
4	Insulating Monitoring Relay	750 V /415 V, 3 Ph	OK / Not OK
		110 V AC/ DC	OK / Not OK
5	Controlled Discharge Toilet System		OK / Not OK

7.0 EQUIPMENT SAFETY TESTS

SNo	Equipments	PP Side observations	NPP Side observations
1.	Blower Motor	OK /Not OK	OK /Not OK
2.	Cond. Fan Motor 1	OK /Not OK	OK /Not OK
3.	Cond. Fan Motor 2	OK /Not OK	OK /Not OK
4.	OHP 1	OK /Not OK	OK /Not OK
5.	OHP 2	OK /Not OK	OK /Not OK
6.	Compressor-1	OK /Not OK	OK /Not OK
7.	Compressor-2	OK /Not OK	OK /Not OK
8.	LP-1	OK /Not OK	OK /Not OK
9	LP-2	OK /Not OK	OK /Not OK
10.	HP-1	OK /Not OK	OK /Not OK
11.	HP-2	OK /Not OK	OK /Not OK
12	CP-1 (By pass)	OK /Not OK	OK /Not OK
13	CP-2 (By pass)	OK / Not OK	OK / Not OK

8.0 PERFORMANCE OF EQUIPMENTS

SNo	Equipments	Performance
1.	WRA 1	OK /Not OK
2.	WRA 2	OK /Not OK
3.	Flasher	OK /Not OK
4.	750 V circuit	OK /Not OK
5.	Feeder 1	OK /Not OK
6.	Feeder 2	OK /Not OK
7.	Water Cooler	OK /Not OK
8.	Hot Case	OK /Not OK
9.	WSP	OK /Not OK
10.	Battery Charger	OK /Not OK
11	Bottle cooler cum deep Freezer	OK /Not OK
12.	Hot Plate	OK /Not OK
13	Refrigerator	OK /Not OK
14.	PAS ckt	OK /Not OK

(Signature of testing In-charge)

Annexure 11.2

PROFORMA FOR RECORD OF PRE-COOLING TEST

Conditions:

1. Type and coach No. ----------
2. Supply Voltage ----------V
3. Ambient temperature ----------(DB) ----------WB

Power panel side:

Rotary Switch Position	Coach Temperature Deg.C at Cut - in	Cut-in Time	Coach Temperature Deg.C at Cut -out	Cut-out Time	Time taken in min
Position 6 i.e. 24.04˚C					

Non-Power panel side

Rotary Switch Position	Coach Temperature Deg.C at Cut - in	Cut-in Time	Coach Temperature Deg.C at Cut - out	Cut-out Time	Time taken in min
Position 6 i.e. 24.04˚C					

Total pre-cooling time:

PP side ----------min.

NPP side ----------min.

(Signature of testing In-charge)

Annexure -11.3

ELECTRICAL TEST REPORT FOR AC COACHES AFTER SS -II

Type of Coach---------- Coach No. ----------

Date of testing ---------- Railway ----------

1.0 Insulation Resistance

S NO	Circuit Voltage	Capacity of Megger used	Min. value of IR required	Actual value observed	Remarks
1.	750V	1000 V	05 M ohm		OK / Not OK
2.	415 V	500 V	03 M ohm		OK / Not OK
3.	230 V	500 V	02 M ohm		OK / Not OK
4.	190 V	500 V	02 M ohm		OK / Not OK
5.	110 V	500 V	02 M ohm		OK / Not OK
6.	24 V	100 V	01 M ohm		OK / Not OK

2.0 Air Conditioning Equipments

a) Electrical load test

S No.	Description	Specified Load current	Actual observed		
			R	Y	B
	AC PLANT NO. 01 (PP SIDE)				
1.	BLR	2.6 ± 10% Amp			
2.	CD1	2.1 ± 10% Amp			
3.	CD2	2.1 ± 10% Amp			
4.	CP1	8.25±25% Amp			
5.	CP2	8.25±25% Amp			
6.	HTR1	10 Amp			
7.	HTR2	10 Amp			
	AC PLANT NO. 02 (NPP SIDE)				
1.	BLR	2.6 ± 10% Amp			
2.	CD1	2.1 ± 10% Amp			
3.	CD2	2.1 ± 10% Amp			
4.	CP1	8.25±25% Amp			
5	CP2	8.25±25% Amp			
6.	HTR1	10 Amp			
7.	HTR2	10 Amp			
Load Current for RMPU					
Voltage for RMPU - 415 ± 10% V					
Total Power Consumption in kVA					
Total Power Consumption in kW					

b) Air delivery test ``````````````````

Sr. No.	Description	Specified	Actual observed	
			PP	**NPP**
1	Fresh Air (FA)	Air delivery-	12.69	12.39
2	Return Air (RA)	0.35 m^3/ min/ passenger	7.23	16.83
3	Exhaust Air (EA)	Approx. 3 x Fresh Air	0.50	4.63
4	Conditioned Air (CA)	Equal or less than 10% of FA Fresh Air + Return Air	---	---
a) Total Fresh Air (PP+NPP)		= 20.08 Cub mtr/ min		
b) Total Return Air (PP+NPP)		= 49.85 Cub mtr/ min		
c) Total Exhaust Air (PP+NPP)		= 9.63 Cub mtr/ min		
d) Total Cond. Air (PP +NPP)		= 147.27 Cub mtr/ min		

3.0 Water Rising Apparatus

S No.	Description	Specified Load current		Actual observed		
		M/s. Elgi	**M/s Kalsi**	**R**	**Y**	**B**
WRA/ Mono Block Pump		Amp	Amp			
1.	1	1.2	1.1			
2.	2	1.2	1.1			

4.0 Pantry Equipments

a) For Coaches

1.	Deep Freezer	OK /Not OK
2.	Bottle Cooler	OK /Not OK
3.	Hot Case	OK /Not OK

b) For Hot Buffet

1.	Hot Case	OK /Not OK
2.	Deep Freezer	OK /Not OK
3.	Water boiler	OK /Not OK
4.	Burners 1, 2 & 3	OK /Not OK
5.	Chimneys 1, 2 & 3	OK /Not OK
6.	Insect Killer	OK /Not OK
7.	Fridge	OK /Not OK

5.0 Lighting Circuits

1.	Working of main lighting circuit	OK /Not OK
2.	Working of emergency lighting circuit	OK /Not OK
3.	Working of stand alone emergency light	OK /Not OK
4.	Night Light	OK /Not OK
5.	Berth reading Light (In case 2T/ FAC)	OK /Not OK
6.	Indication Lights	OK /Not OK

6.0 Testing Of Switch Board Cabinet

1.	Battery Charger		OK /Not OK
2.	Emergency Battery Charger		OK /Not OK
3.	Exhaust Fans		OK /Not OK
4.	Insulation Monitoring Relay	750 /415V, 3 Ph	OK /Not OK
		110V AC/ DC	OK /Not OK
5.	Controlled Discharge Toilet System		OK /Not OK

(Signature of testing Incharge)

7.0 Pre Cooling Test

TEST CONDITIONS: _____
Coach Location ----------
Time from ---------- hrs. to ---------- hrs.
Ambient Temperature (DB) --------- º C. (WB) --------- º C.

S. No.	Time taken for Pre- cooling test	Specified	Actual observed	
			PP side	NPP side
1.0	From 45 to 24.04 ºC (Temperature setting on position 6)	Less than 01 hour		

Time taken for pre-cooling test: ----------Min/hr.

Satisfactory / Unsatisfactory

8.0 Pull Down Test

TEST CONDITIONS
Coach Location ----------
Time from ----------hrs. to ---------- hrs.
Ambient Temperature at starting (DB) ---------- º C. (WB)---------- º C.
Ambient Temperature at finish (DB) ---------- º C. (WB)---------- º C.
Average compensation load ……..k Watts

S.No.	**Time taken for Pull down test**	**Specified**	**Actual observed**	
			PP side	**NPP side**
	From 45 to 24.04º C	Not more than 02 hrs.		

Pull down time to achieve 24.04 º C ----------hrs.

Satisfactory / Unsatisfactory

9.0 Electrical Test Report for AC Coaches

9.1 Equipment Safety Tests

SNo	Equipments	PP Side observations	NPP Side observations
1.	Blower Motor	OK /Not OK	OK /Not OK
2.	Cond. Fan Motor 1	OK /Not OK	OK /Not OK
3.	Cond. Fan Motor 2	OK /Not OK	OK /Not OK
4.	OHP 1	OK /Not OK	OK /Not OK
5.	OHP 2	OK /Not OK	OK /Not OK
6.	Compressor-1	OK /Not OK	OK /Not OK
7.	Compressor-2	OK /Not OK	OK /Not OK
8.	LP-1	OK /Not OK	OK /Not OK
9	LP-2	OK /Not OK	OK /Not OK
10.	HP-1	OK /Not OK	OK /Not OK
11.	HP-2	OK /Not OK	OK /Not OK
12	CP-1 (By pass)	OK /Not OK	OK /Not OK
13	CP-2 (By pass)	OK / Not OK	OK / Not OK

9.2 Performance of Equipments

SNo	Equipments	Performance
9.	WRA 1	OK /Not OK
10.	WRA 2	OK /Not OK
11.	Flasher	OK /Not OK
12.	750 V circuit	OK /Not OK
13.	Feeder 1	OK /Not OK
14.	Feeder 2	OK /Not OK
15.	Water Cooler	OK /Not OK
16.	Hot Case	OK /Not OK
9.	WSP	OK /Not OK
10.	Battery Charger	OK /Not OK
11	Bottle cooler cum deep Freezer	OK /Not OK
12.	Hot Plate	OK /Not OK
13	Refrigerator	OK /Not OK
14.	PAS ckt	OK /Not OK

Signature of Testing In-charge

Annexure-11.4

SAMPLE CALCULATION FOR CALCULATING COMPENSATING LOAD

To find out electrical compensating load to be provided inside the coach when coach is tested at other than the designed outside ambient condition say 40º C (104 ºF) DB and 30 ºC (86º F) WB

Coach: Self generating chair car to CSC layout No. 1559 for 71 passengers.
Designed (outside) conditions = 45 º C (113 º F) DB & 25ºC (77ºF) WB
Designed (outside) conditions = 25 ºC (77 ºF) DR & 40% RH

A. Heat gain inside the coach at designed conditions:

i. Conduction = 11,045 B.Th.U/hrs.

Formulae = Area x Overall coefficient of heat transfer in B. Th.U/ hr/ ºF/ sq.ft x temperature difference

a) Side wall = 2 x 236 x 0.127 x 36 = 2980.944
b) End partition walls = 2 x 73 x 0.127 x 31 = 667.512
c) Roof = 550 x 0.134 x 36 = 2653.2
d) Floor = 514 x 0.149 x 36 = 2757.096
e) Windows = 2 x 69 x 0.4 x 36 = 1987.2

Where 0.127 is the factor for heat transfer through walls, 0.134 is for roof and 0.149 is for the floors. For glass windows the factor for heat transfer has been taken as 0.4.

ii) Solar radiation = 15193.4 B.Th.U/ hrs.

Formula = Area x Overall coefficient of heat transfer x solar temperature difference

a) Side wall = 326 x 0. 127 x 16 = 662.4
b) Roof = 550 x 0.134 x 19 = 1400.3
c) Windows = 69 x 1.1 x 173 = 13130.7

Where 16.19 & 173 are the solar temperature differences as per tranes air-conditioning manual page 314 and 315 for 30 ºC N latitude at 16 hrs.

iii) Passengers (@ 400 B. Th. C per passenger 71 x 400) = 28,400 B.Th.U / hr

iv) Light and fans (3.4 B.Th.U/ hrs per watt for lights and 3600 B.Th.U/hrs for small motors) = 8,275 B. Th. U/ hr

a) Tube lights = 22 x 30 x 3.4 = 2244 B.Th.U/hr
b) Carriage fans = (8 x 35 x 3600)/ 746 = 1351 B.Th.U/hr
c) Blower motor = 2 x 0.65 x 3600 = 4680 B.Th.U/hr

v) Ventilation = 51,365 B.Th.U/hr

a) Sensible = 1.1 x Nos. of person x cfm of air per person x temperature difference.

= 1.1 x 71 x 12.4 x 36

= 34864 B.Th.U/hr

b) Latent = 0.68 x No. of person x cfm of per person x difference of grains of moisture between outside air & conditioned air. **

= 0.68 x 71 x 12.4 x (82 - 56)

= 16501 B.Th.U/hr

Formula = For sensible heat gain as per tranes air conditioning manual page 88 and for latent heat gain formula 23 on page 150 of carrier handbook of air conditioning and ventilation.

Total heat gain = 1,14,729 B.Th.U/hr

Adding 10% for leakage heat gain = 1,25,707 B.Th.U/hr

B) Heat gain during test at outside ambient = 104 - 77

Conditions of 40 º C (DB) and 30 ºC (WB) temperature difference = 27 º C

i) Conduction = (11046 x 27)/ 36 = 8284 B.Th.U/hrs

ii) Light & fan = 8275 B.Th.U/hrs

iii) Ventilation

a) Sensible = (34867 x 27)/ 36 = 26148 B.Th.U/hrs

b) Latent = 0.68 x 71 x 12.4 x (161-56)**

= 62861 B.Th.U/hrs

Total heat gain under actual test condition = 105568 B.Th.U/hrs

Therefore electrical load to be provided inside the coach to produce heat units = 125707-105568 B.Th.U/hrs = 20, 139 B.Th.U/hrs

Therefore electrical load in kW = 20139/(3.41x1000)

= 5.906 kW

** To be determined from the outside and inside conditions on physcrometic chart.

Annexure – 11.5

PROFORMA TO RECORD PULL DOWN TEST

1. Type and Coach No. ……
2. Supply Voltage ……V
3. Ambient temperature …….DB…….WB
4. Electrical compensating heat load provided…….kW

Temp setting at position 6 (i.e.24.04°C)	**Time when Compensating Electric Load switched 'ON'**	**Time when both plants switched 'ON'**	**Coach temperature when both plants switched 'ON'**	**Time of plants cutting 'OFF'**		**Coach temperature when both plants switched 'OFF'**	
				Plant 1	Plant 2	Plant 1	Plant 2
			45º C				

Total time taken by both plants to switch „OFF"

PP side ……....min.

NPP side …….min.

Signature of Testing In-charge

Annexure 11.6

FINAL JOINT INSPECTION REPORT OF LHB EOG AC COACHES

Coach Particulars		
S.No.	**Particulars of the coach**	**Details**
1.	Coach No.	
2.	Depot / Railways	
3.	Workshop name	
4.	Coach booked on	
5.	Coach booked for SS-I/ SS-II	
6.	Date of Inspection	
7.	Return Date	

Final Checking

S.No.	**Description of Checks**	**Observations / Remark**
1.0	**Roof Mounted AC Package Unit (RMPU)**	
1.1	**Compressor**	
	Make of Compressor PP Side NPP Side	 1. 2. 1. 2.
	Condition of anti-vibration mountings PP Side NPP Side	 1. OK / Not OK 2. OK / Not OK 1. OK /Not OK 2. OK /Not OK
	Condition of terminal boxes PP Side NPP Side	 1. OK / Not OK 2. OK / Not OK 1. OK /Not OK 2. OK /Not OK
	Any abnormal noise during run PP Side NPP Side	 1. 2. 1. 2.
1.2	**Condenser Motors**	
	Make of condenser motor PP Side NPP Side	 1. 2. 1. 2.
	Condition of terminal boxes PP Side NPP Side	 1. OK / Not OK 2. OK / Not OK 1. OK /Not OK 2. OK /Not OK
	Abnormal noise noticed during run PP Side NPP Side	 1. 2. 1. 2.

S.No.	Description of Checks	Observations / Remark
1.3	**Evaporator Motor**	
	Make of evaporator motor PP Side NPP Side	 1. 2. 1. 2.
	Condition of terminal boxes PP Side NPP Side	 1. OK / Not OK 2. OK / Not OK 1. OK /Not OK 2. OK /Not OK
	Any abnormal noise noticed during run PP Side NPP Side	 1. 2. 1. 2.
	Condition of drip tray PP Side NPP Side	 OK /Not OK OK /Not OK
1.4	**Servo Motor**	
	Make of Servo motors PP Side NPP Side	 1. 2. 1. 2.
	Condition of Servo Motors PP Side NPP Side	 1. OK / Not OK 2. OK / Not OK 1. OK /Not OK 2. OK /Not OK
1.5	**Heating Elements**	
	Make of Heating Elements PP Side NPP Side	 1. 1.
	Condition of Heating Elements PP Side NPP Side	 1. OK / Not OK 1. OK /Not OK
1.6	**Filters**	
	Make of Filters Return air PP Side NPP Side Fresh air PP Side NPP Side	 1. 2. 1. 2. 1. 2. 1. 2.
	Condition of Filters Fresh air Return air	 1. OK / Not OK 2. OK / Not OK 1. OK /Not OK 2. OK /Not OK

S.No.	Description of Checks	Observations / Remark
1.7	**Protection Devices**	
	Condition of HP output	
	PP Side	1. OK / Not OK 2. OK / Not OK
	NPP Side	1. OK /Not OK 2. OK /Not OK
	Condition of LP cutouts	
	PP Side	1. OK / Not OK 2. OK / Not OK
	NPP Side	1. OK /Not OK 2. OK /Not OK
	Condition of control pressure switch	
	PP Side	OK /Not OK
	NPP Side	OK /Not OK
	Condition of ESTI fusible link	
	PP Side	OK / Not OK
	NPP Side	OK / Not OK
	Condition of OHP	
	PP Side	OK / Not OK
	NPP Side	OK / Not OK
	Condition of temperature sensors	
	PP Side	OK / Not OK
	NPP Side	OK / Not OK
	Condition of humidity sensors	
	PP Side	OK / Not OK
	NPP Side	OK / Not OK
1.8	**Refrigerant Pipe Line**	
	Condition of Clamping of pipe line	
	PP Side	OK / Not OK
	NPP Side	OK / Not OK
2.0	**Switch Board Cabinet**	
	Condition of rotary switches	OK / Not OK
	Condition of MCBs for	
	Light	OK / Not OK
	Fan circuit	OK / Not OK
	Other MCBs	OK / Not OK
	Condition of terminals	OK / Not OK
	Condition of contractors	OK / Not OK
	Condition of relays	OK / Not OK
	Condition of meters	
	Ammeters	OK / Not OK
	Voltmeters	OK / Not OK
	Pressure Gauges	OK / Not OK

S.No.	Description of Checks	Observations / Remark
	Condition of cable	OK / Not OK
	Condition of clamping of cables	OK / Not OK
	Condition of conduits	OK / Not OK
3.0	**Compartment**	
	Condition of exhaust fans	OK / Not OK
	Condition of lights	OK / Not OK
	Condition of berth lights	OK / Not OK
	Condition of switches	OK / Not OK
	Condition of indication lights	OK / Not OK
4.0	**Micro Processor Controller**	
	Micro processor controller	OK / Not OK
	Condition of connections	OK / Not OK
	Condition of LEDs	OK / Not OK
5.0	**Battery**	
	Make Lug date	
	Battery box suspension arrangement	OK / Not OK
	Battery cells ventilation	OK / Not OK
	Battery box inside anti corrosion painting	OK /Not OK
	Condition of battery lugs	OK / Not OK
	Condition of cell container	OK / Not OK
	Condition of battery fuse & fuse box	OK / Not OK
	Earth leakage of battery	leakage / Not leakage
	Battery no load voltage in volts	_____volts
6.0	**Battery Charger**	
	Make of battery charger	
	Condition of battery charger	OK / Not OK
	Condition of battery charger mounting arrangement	OK / Not OK
7.0	**Pantry Equipments**	
	Condition of Deep freezer	OK / Not OK
	Condition of bottle cooler	OK / Not OK
	Condition of water boiler	OK / Not OK
	Condition of hot case	OK / Not OK

8.0	**EOG Coupler**	
	Condition of coupler PP Side NPP Side	 1. OK / Not OK 2. OK / Not OK 1. OK /Not OK 2. OK /Not OK
	Condition of coupler pins PP Side NPP Side	 1. OK / Not OK 2. OK / Not OK 1. OK /Not OK 2. OK /Not OK
	Condition of locking arrangement PP Side NPP Side	 1. OK / Not OK 2. OK / Not OK 1. OK /Not OK 2. OK /Not OK
9.0	**60 KVA Transformer**	
	Condition of mounting arrangement	OK /Not OK
	Condition of terminals	OK /Not OK
10.0	**Lighting Transformer**	
	Condition of mounting arrangement	OK /Not OK
	Condition of terminals	OK /Not OK
11.0	**Other Equipments**	
	Condition of WRA	1. OK /Not OK 2. OK /Not OK
	Condition of micro controller for WRA	OK /Not OK
	Condition of pre cooling socket	1. OK /Not OK 2. OK /Not OK
12.0	**Earthing of all Equipments**	Provided / Not Provided
13.0	**Pantry Equipments**	
	Hot Case	OK / NOT OK
	Deep freezer	OK / NOT OK
	Water boiler	OK / NOT OK
	Chimney 1,2,3	OK / NOT OK
	Burner 1,2,3	OK /Not OK
	Insect Killer	OK /Not OK
	Fridge	OK /Not OK
	Working of call station	OK /Not OK

Equipments Replaced

S.No	Name of Equipment	Make	Rating/ Capacity	Serial No.

(Signature of Inspecting Supervisor from Depot/ Railway)

(Signature of Inspecting Supervisor from Work Shop)

****

Annexure 11.7

LIST OF MUST CHANGE ITEMS FOR LHB AC COACHES

S.No.		Items	First POH	Second POH
1	**Switch Board Cabinet:**			
	a	MCBs for Pantry Equipments,F-16,F-18, F-19,F-20	Y	
	b	MCBs for Pump Controller F-36		Y
	c	MCBs for Compressors F-03,F-05,F-09,F-11	Y	
	d	MPCB for Pumps, F-21 & F-22	Y	
	e	Contactor for Compressor K-33, K-34, K-38, K-39	Y	
	f	Contactor for Blower Fan Motor K-26,K-28		Y
	g	Contactor for Condenser Fan Motor K-31,K-32, K-36, K-37		Y
	h	Contactor for Heater K-35,K-40		Y
	i	Contactor for Output of 60KVA Transformer, K-44	Y	
	j	Timer for External Power Supply/LMS, K-18	Y	
	k	Timer for Light ON/OFF, K-17	Y	
	l	Minimum Voltage Relay(MVR), U-2.3		Y
	m	Rotary Switch for Disconnecting & Earth Device,A-2	Y	
	n	DC to DC converter (110V/24V) for Pump control & Sanitary control, U-2.1		Y
	o	Rotary Switch Power Supply ON/OFF, S-01	Y	
	p	Rotary Selector Switch Net-1,Net-2 & LMS, S-02	Y	
	q	Interlock Contactor for Changeover of Coach light supply from 110V AC to 110V DC & Vice versa, K-48	Y	
	r	Measuring & Monitoring Relay MMRs, K-03 & K-04		Y
	s	Main Feeder Contactors, K-01 & K-02		Y
	t	Electronic Module for Contactors, K-01, K-02	Y	
	u	Door for complete Switch Cabinet unit		Y
2	**Light Fittings**			
	a	Lavatory Light Fitting	Y	
	b	Lavatory Exhaust Fan		Y
	c	Diffuser for Rajdhani Exp Coaches		Y
	d	Mobile Switch Socket complete		Y
3	**Pantry Equipments**			
	a	3Pin Sockets/MCBs for operation of equipments	Y	
	b	Hot Water Boiler/Geyser	Y	
	c	Heating Element assembly complete with Blower unit rotary switch, thermostat & indicator for Hot cases	Y	
	d	Filter of Electric Chimney	Y	
	e	Pantry Exhaust Fan		Y

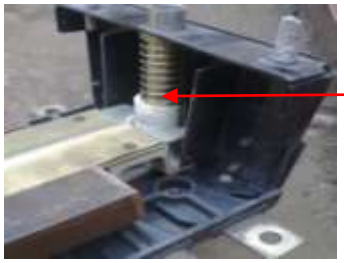
4	**Roof Mounted AC Package Unit**			
	a	Canvas Duct for Return Air	Y	
	b	Canvas Duct for Supply Air	Y	
	c	Canvas Duct for Fresh Air	Y	
	d	Anti Vibration Mounting Pad	Y	
	e	Filter media mix air	Y	
	f	Filter cassette Fresh air	Y	
	g	ESTI cartridge Bulb	Y	
	h	Over Heat Protection Switch	Y	
	i	NTC sensors		Y
	j	Thermal Insulation Sheet	Y	
	k	Earthing Shunt		Y
	l	Rotary Switch ON/OFF for AC plant	Y	
	m	Fresh Air Filter Assembly	Y	
	n	FRP Blade for Condenser Fan Blade		Y
5	**ZS Coupling**			
	a	Contact Pin assembly for Phases, Neutral & Earth with Springs	Y	
	b	Connector Female assembly Phases, Neutral & Earth with Springs	Y	
	c	Ratchet arrangement for coupling sockets assembly	Y	
	d	Insulating Base with fixing screw kit for coupling socket	Y	
	e	Insulating Base with fixing screw kit for Jumper Plug assembly	Y	
	f	Hinged cover assembly for Blind socket	Y	
	g	Ratchet arrangement for Blind socket assembly	Y	
	h	PMA protective sleeve for cables	Y	
	i	Conduit seal ring & all type gaskets	Y	
	j	Coupling socket housing assembly	Y	
	k	Lever Tie Bow RH & LH	Y	
	l	Connecting link lever arm	Y	
	m	Rivet Pin link long	Y	
	n	Complete ZS coupling with ratchet sockets assembly & Blind socket		Y
6	**Mono block Pump**			
	a	Complete Mono block Pump unit	Y	
7	**Battery Fuse Box**			
	a	Positive Battery Fuse Box Complete	Y	
	b	Negative Battery Fuse Box Complete	Y	

Annexure 11.8

PHOTOGRAPHES OF MUST CHANGE ITEMS FOR LHB AC COACHES

S.No.	Items	
1	**Switch Board Cabinet**	
	a	 **MCBs for Pantry Equipments,F-16,F-18, F-19,F-20**
	b	 **MCBs for Pump Controller F-36**
	c	 **MCBs for Compressors F-03,F-05,F-09,F-11**
	d	 **MPCB for Pumps, F-21 & F-22**

	e	 **Contactor for Compressor K-33, K-34, K-38, K-39**
	f	 **Contactor for Blower Fan Motor K-26,K-28**
	g	 **Contactor for Condenser Fan Motor K-31,K-32, K-36, K-37**
	h	 **Contactor for Heater K-35,K-40**
	i	 **Contactor for Output of 60KVA Transformer, K-44**

	j	 **Upper Spring** **Upper Housing Feeder Contactor Spring**
	k	 **Return Spring** **Return Housing Feeder Contactor Spring**
	l	 **Return Spring** **Return Housing Contactor Spring**
	m	 **Timer for External Power Supply/LMS, K-18**
	l	 **Timer for Light ON/OFF, K-17**

	n	 **Minimum Voltage Relay(MVR), U-2.3**
	o	 **Rotary Switch for Disconnecting & Earth Device,A-2**
	p	 **DC to DC converter (110V/24V) for Pump control & Sanitary control, U-2.1**
	q	 **Rotary Switch Power Supply ON/OFF, S-01**
	r	 **Rotary Selector Switch Net-1,Net-2 & LMS, S-02**

	s	 **Interlock Contactor for Changeover of Coach light supply from 110V AC to 110V DC & Vice versa, K-48**
	t	**Measuring & Monitoring Relay MMRs, K-03 & K-04**
	u	 **Main Feeder Contactors, K-01 & K-02**
	v	 **Electronic Module for Contactors, K-01, K-02**
	w	  **Door for complete Switch Cabinet unit**

Light fittings

2	**Light Fittings**	
	a	 **Lavatory Light Fitting**
	b	 **Lavatory Exhaust Fan**
	c	 **Diffuser for Rajdhani Exp Coaches**
	d	 **Mobile Switch Socket complete**

Pantry Equipment

3	**Pantry Equipment**	
	a	 **3Pin Sockets/MCBs for operation of equipment**
	b	 **Hot Water Boiler/Geyser**
	c	 **Heating Element assembly complete with Blower unit rotary switch, thermostat & indicator for Hot cases**
	d	 **Filter of Electric Chimney**
	e	 **Pantry Exhaust Fan**

ZS Coupling

5		**ZS Coupling**
	a	 **Contact Pin assembly for Phases, Neutral & Earth with Springs**
	b	 **Connector Female assembly Phases, Neutral & Earth with Springs**
	c	 **Ratchet arrangement for coupling sockets assembly**
	d	 **Insulating Base with fixing screw kit for coupling socket**
	e	 **Insulating Base with fixing screw kit for Jumper Plug assembly**

	f	 **Hinged cover assembly for Blind socket**
	g	 **Ratchet arrangement for Blind socket assembly**
	h	 **PMA protective sleeve for cables**
	i	 **Conduit seal ring & all type gaskets**
	j	 **Coupling socket housing assembly**
	k	 **Lever Tie Bow RH & LH**

	l	 **Connecting link lever arm**
	m	 **Rivet Pin link long**
	n	  **Complete ZS coupling with ratchet sockets assembly & Blind socket**

Mono block Pump

6		**Mono block Pump**
	a	 **Complete Mono block Pump unit**

Battery Fuse Box

7	**Battery Fuse Box**	
	a	 **Positive Battery Fuse Box Complete**
	b	 **Negative Battery Fuse Box Complete**

Annexure 11.9

ELECTRICAL TOOLS, MACHINE & PLANT

The facilities mentioned below are bare minimum. However, if some facilities are already available (either in mechanical or electrical sick line) only supplementing would be necessary. Effort should always be made to complete both electrical and mechanical maintenance in single placement of the rake.

A. REPAIRING & TESTING FACILITIES

S.N.	ITEM	COACH HOLDING				
		0-50	51-100	101-250	251-500	501-1000
1.	Engine sub assemblies repairing & calibration facilities	1	1	2	2	3
2.	FIP pump & injector repairing, testing and calibration facilities	1	1	2	2	3
3.	I.V. coupler/ HOG coupler & ratchet wheel repairing and testing facilities	1	1	1	2	2
4.	Filter cleaning arrangements with blower & water sump for cleaning/ drying air filters	1	1	2	2	2
5.	Radiator cleaning tank size 2W x 4L x 2D (in meters).	--	1	1	1	1
6.	Condenser cleaning tank size 2W x 4L x 2D (in meters).	--	1	1	1	1
7.	Microprocessor based Electronic card reading and repairing facilities.	--	--	1	1	1
8.	HSD oil decantation facility with pump for generator car shed of suitable capacity.	--	1	1	1	1
9.	500 kW load testing facility for power car (Inductive/ Resistive)	1	1	2	2	2
10.	Test bench for Diesel engine (Dynamometer type)	1	1	2	2	2
11.	Test bench for on load testing of Alternator of power car	--	--	1	1	1
12.	Testing supply points 750V 3 phase	At each coach length				
13.	Portable Step up transformer 415/750, 50/60kVA	1	1	2	2	4

S.N.	ITEM	COACH HOLDING				
		0-50	51-100	101-250	251-500	501-1000
14.	Test bench for testing relays & contactors	1	1	2	2	2
15.	Power supply analyzer, oscilloscope dual channel, storage type	1	1	2	2	2
16.	Sealed compressor repair/ testing facility	--	1	1	1	1
17.	Testing facility of RBC and emergency battery charger	1	1	1	2	2
18.	WRA/ Mono-block pump testing facility	1	1	1	2	2

B. MACHINE & PLANT

S.N.	ITEM	COACH HOLDING				
		0-50	51-100	101-250	251-500	501-1000
1.	Arial lifting platform for climbing on roof of coach.	1	1	2	2	3
2.	EOT crane 5T	1	1	2	2	4
3.	Mobile Jib crane mounted on lister 1.5T	1	1	2	3	4
4.	Distilled water plant – preferably solar system, (in ltrs per day)	1x 100 lpd	1 x 100 lpd	1 x 500 lpd	2 x 500 lpd	2 x 500 lpd
5.	Portable Transformer type arc welding set complete.	1	1	2	2	3
6.	Hydraulic operated scissor – type platform truck of 1T capacity.	1	1	2	2	3
7.	Vacuum pump with gauges etc.	1	1	2	4	6
8.	Portable high pressure water jet washing machine with electric motor driven pump.	2	2	4	4	6
9.	Gas cutting set	1	1	2	2	4
10.	Battery charger sets suitable for 440V, 3 phase, 50Hz AC input & 110V, 200A DC current complete with accessories for charging	2	2	4	4	6

	batteries					
S.N.	ITEM	**COACH HOLDING**				
		0-50	**51-100**	**101-250**	**251-500**	**501-1000**
11.	Pre cooling sockets with universal type connector	At each coach length.				
12.	Constant current constant voltage battery charger for 2 monoblocks	1	1	2	2	2
13.	Portable battery charger up to 15 amps. Capacity	1	2	2	4	4
14.	Constant current discharger	1	1	2	2	4
15.	Battery analyzer	1	1	1	1	2
16.	Motor driven portable air compressor set with reservoir of suitable capacity	1	1	2	2	4
17.	Lathe machine, 1000mm between center complete including spares and accessories with attachment for precision grinding and tapering.	--	--	1	1	1
18.	Dynamic balancing machine for balancing of fans, shafts & alternator pulley.	1	1	1	1	1
19.	Medium sized electric motor driven pillar-drilling machine complete.	1	1	2	2	2
20.	Bench vice	2	2	4	4	6
21.	Heavy-duty motor driven pedestal grinder complete	1	1	2	2	2
22.	Hydraulic puller 50T	--	--	1	1	1
23.	Hydraulic puller 10T	1	1	2	2	4
24.	Hydraulic press machine 2T	--	1	1	1	2
25.	Portable electric motor driven drill machine	2	4	6	8	10
26.	Portable electric motor driven grinder	1	2	3	4	5
27.	Escorting staff tool boxes with tool kit as per RDSO	For each escorting technician				

Note: Air quality measurement facility and DG set exhaust air pollution check facility have been withdrawn due to high value items as discussed in the meeting held at Jagadhari workshop on 19.04.2012.

S.N.	ITEM	COACH HOLDING				
		0-50	51-100	101-250	251-500	501-1000
28.	Motorised Megger upto 2.5 kV	1	2	2	4	4
29.	Vacuum cleaner industrial type	1	2	2	4	4
30.	Refrigerant recovery plant	1	1	2	2	4
31.	Electronic weighing machine up to 15kg	1	1	2	2	3
32.	Electronic weighing machine up to 500kg	1	1	2	2	3
33.	Testing equipment (variable voltage supply AC & DC, transistor tester, meter testing kit etc.)	2	2	4	4	6
34.	Electric motor driven de-watering pump set for pits.	1	1	2	2	2
35.	Portable electric motor driven blower	2	2	4	4	6
36.	46.7 Ltrs spare oxygen (7 m3) cylinders	2	4	4	8	15
37.	41 Ltrs spare Acetylene (5.5 m3) gas cylinders	2	4	8	8	15
38.	46.7 Ltrs spare Nitrogen (7 m3) gas cylinders	2	4	8	8	15
39.	Spare R-134a refrigerant cylinders	4	6	8	10	15
40.	Oven for drying electrical motor etc. size as per requirement.	1	1	1	1	1
41.	DG set, 415V of adequate capacity as standby power supply.	1	1	1	1	1
42.	Step up transformer 415V/ 750 V of adequate capacity as standby power supply.	1	1	1	1	1
43.	415V/ 750 V power supply points along the pit	At each coach length				
44.	Injector testing & calibration machine.	1	1	2	2	2
45.	Injector leakage testing machine	1	2	2	4	6

C. TOOLS

S.N.	ITEM	COACH HOLDING				
		0-50	51-100	101-250	251-500	501-1000
1.	**Set of Miscellaneous tools:** Torque wrenches Special spanner Soldering iron De-soldering pump Manual cable crimping tool Hydraulic crimping tool Cable stripper Cable cutter Pliers Screw drivers Line tester Cell tester Test lamp Hammers Mallets Riveting tool Punching tool	5 sets	5 sets	10 sets	10 sets	15 sets
2.	**Set of Measuring tools:** Dial indicators Filler gauge sets Vernier calipers Vernier micrometers Torque wrench Depth gauges Screws gauge Go/No Go gauges Hydrometer etc.	2 sets	2 sets	5 sets	5 sets	10 sets
3.	**Set of Special tools for RMPU:** Refrigerant leak detector Tube cutters Pinch off tool Flaring tool Charging line Hand shut off valves Combination gauge Air flow meter Contact less thermometer	2 sets	2 sets	5 sets	5 sets	10 sets

S.N.	ITEM	COACH HOLDING				
		0-50	51-100	101-250	251-500	501-1000
	LP gauge HP gauge Tube bender Lapping machine					
4.	**Set of Electrical testing tools:** Digital multi meters Industrial grade AC & DC voltmeters Industrial grade AC & DC ammeter Digital tongue tester Insulation tester Contact less thermometer Digital thermometer Infrared thermometer Non contact type digital tachometer Anemometer Hygrometer Lux meter	2 sets	2 sets	5 sets	5 sets	10 sets
5.	Digital dB meter (Noise level indicator)	2	2	2	4	6
6.	Shock pulse meter	1	2	3	4	6
7.	Techco meter	1	1	1	2	2

D. SAFETY EQUIPMENTS

S.N.	ITEM	COACH HOLDING				
		0-50	51-100	101-250	251-500	501-1000
1.	All workmen safety equipments such as industrial helmets, hand gloves, industrial shoes, nose masks, minor light etc.	As per requirement				
2.	Fire extinguishers, sand buckets with stand	As per requirement				
3.	Safety belts for working on the roof of the coach.	As per requirement				
4.	First aid boxes	As per requirement				

NOTE

CHAPTER 12

MAINTENANCE SCHEDULES (MECHANICAL)

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CHAPTER 12

MAINTENANCE SCHEDULES

12.1 GENERAL

The following maintenance schedules are to be carried out.

Coaching Depot Schedule

- Schedule D1 : Every Trip/Weekly
- Schedule D2 : Monthly ± 3 days
- Schedule D3 : Half Yearly ± 15 days

Shop Schedule

- Shop Schedule I : 18 months/ 6 lakh Kms whichever is earlier
- Shop Schedule II : 36 months/ 12 lakh Kms whichever is earlier
- Shop Schedule III : 72 months/ 24 lakh Kms whichever is earlier

The details of activities to be carried out during these schedules are given below and a summarized checklist is given in Annexure 12.5.

12.2 SCHEDULE D1 (EVERY TRIP/WEEKLY)

The following items shall be attended during schedule D1.

Bogie Frame and Bolster Assembly

- Perform a visual check on longitudinal beams, cross beams & bolster for cracks, damages and corrosion.
- Perform a visual check on brake supports, damper supports, traction centre supports and anti roll bar supports for cracks, damages and corrosion.
- Check bogie bolster sub-assembly and brackets for cracks, damages and corrosion.

Brake Equipments

- Check functionality of Air Brake equipment and Hand brake equipment. Check flex ball cable arrangement for proper working.
- Perform a visual check on Brake cylinders/ brake levers and Hand brake equipment for damage, cracks and corrosion.
- Perform a functional test on pneumatic brake system. Make sure that no leaks are present.
- Check operation of passenger emergency valve & pull box.
- Perform a visual check on hoses for cracks/damages.
- Visually inspect steel piping for cracks/ damages/ ballast hitting and leakages, Repair/ replace as necessary.
- Perform a visual check on brake discs for damage/wear/broken ribs. Verify absence of axial movement along the axle.

Note: For attending Brake Discs with broken ribs, please refer to M/S Knorr Bremse‟s letter no. kbi/m&s/lhb/ser. Dt. 31.08.2007.

Axle Bearing Instruments

- Perform a visual check on all grounding cables & WSP equipment cables for breaks/ damages.
- Visually check equipment for absence of damages, cracks, and corrosion marks.
- Check functioning of WSP equipment. Verify that the signal arrives correctly to the diagnostic equipment.

Primary & Secondary Suspension

- Visually check springs for cracks, damages, corrosion or foreign objects presence.
- Check miner pads for cracks, damages and ageing.
- Visually check safety cables for damages, cracks and corrosion.

Primary/Secondary/Yaw dampers

- Perform a visual check on dampers for damage, cracks and oil leaks.
- Perform a visual check on all fixings for loosening and/or missing components.
- Perform a visual check on rubber elements for cracks and ageing.

Bearings

- Carry out bearing feeling for detection of hot bearing.
- Check bearings for grease leakage.

Wheel & Axle

- Perform a visual check on wheels for cracks, damages and tyre defects.
- Check by wheel profile gauge, the wheel flange thickness and profile.
- Check axle for cracks and signs of corrosion, if any.

Note: please refer to RDSO CMI – K 003 (Guidelines for interpretation of wheel defects) and „Maintenance Manual for ICF design BG coaches" for details.

Control Arm

- Perform a visual check on all fixings for loosening and / or missing components.
- Visually check control arm parts for damages, cracks or corrosion marks.
- Inspect the rubber joint until it is visible for cracks, damages and ageing.

Anti Roll bar Assembly

- Perform a visual check on Anti roll bar, links and brackets for cracks, damages and corrosion.
- Perform a visual check on rubber joints for cracks, damage and ageing.

- Visually inspect for grease oozing out of anti roll bar bearings, which may result in bearing failure.
- Perform visual check on all fixings for loosening/missing fittings.

Traction Centre

- Perform a visual check on the traction centre lever and on the rods for cracks, damages and corrosion.
- The assembly should be free to move, and not blocked by any foreign objects.
- Perform a visual check on all fixings for loosening.
- Perform a visual check on rubber joints for cracks/damages.

Rotation Limiter

- Perform a visual check of rotation limiter- components.

Rubber and Rubber/Metal Bonded Parts

- Perform a visual check on rubber and rubber/metal bonded parts for cracks, damages and ageing.

12.3 SCHEDULE D2 (MONTHLY)

Perform all the items of schedule D1. In addition to this perform the activities- as given below.

Bogie Frame

- Wash the bogie frame thoroughly with water jet in washing line, making sure that water is not directed towards pneumatic / electrical connections and axle bearings.

Brake Equipment

- Verify that the clearance between each pad and disc surface is 1-1.5 mm.
- Check wear of brake pads/ brake discs. If groove depth is reached, it is necessary to replace the discs.
- Lubricate the brake levers, fixings and all moving parts using prescribed grease (Autol Top 2000 spray).

Axle Bearing Instruments

- Inspect the Earthing equipment for wear of slip assembly / carbon bars.
- Monthly / Quarterly inspection of WSP equipment to be carried out as per schedule given by OEM.

Wheel & Axle

- Check treads diameter and wear of wheel profile. If necessary, perform re-profiling.

Pins and Bushes

- Lubricate all pins and bushes.

12.4 SCHEDULE D3 (HALF YEARLY)

Perform all the activities of schedule D2. In addition to this, perform the activities, as given below

Bogie Frame

- Examine the bogie frame for corrosion / damages, especially at critical locations.
- Carry out paint touch up with high built epoxy primer and paint as per RCF specifications MDTS – 166.

Wheel & Axle

- Check wheels offset on axle (1600 mm± 1 mm)

Control Arm

- Renew protection treatment with Tectyl / Cortec VC 1368 on the rubber joint on visible areas.

Axle Bearing Instruments

- Replace all carbon brushes on earthing devices.

12.5 SHOP SCHEDULE-I (18 MONTHS)

The following activities shall be carried out in Shop Schedule-I.

Brake Equipment

- Perform function test of the Air Brake system components:
  - Distributor valve
  - Check valve
  - Isolating cocks/angle cocks
  - Filters, indicators, test fittings.
  - Emergency brake valve & pull box
  - Brake cylinders
  - 8WSP Equipment
- Brake gear pins and other bogie pins must be examined for wear and re-greasing. Replace, if necessary.
- Examine BP/FP couplings and hoses. Replace, if necessary.
- Examine the Brake calipers and Brake pads for wear and damages. Replace, if necessary.
- Check the functioning of hand brake equipment. Replace the defective components.

- Examine the brake discs to detect any thermal or fatigue cracks. Replace, if necessary. Brake disc bolts should be checked for tightness.

Axle Box Instruments

- Overhaul the grounding equipment. Check spring mechanism for self-regulation. Replace carbon bar and slip assembly. Replace all worn parts.
- Carry out overhauling and testing of WSP equipment as per OEM"s instructions.

Primary/Secondary Suspension

- Attention to springs during Shop Schedules shall be as given under Para 12.11.
- Examine the condition of lift stop pin and safety cables. Replace, if necessary.
- Check lower and upper centering discs for corrosion, wear, damage and cracks. Replace, if necessary.
- Examine the condition of rubber and rubber/metal bonded parts for damage, cracks and ageing. (Miner pads, rubber springs etc.). Replace, if necessary.

Dampers

- Check dampers for correct functionality, absence of deformations and oil leakages. Replace fixings/fasteners, if necessary.
- Damper should be tested during Shop Sch.-I and Shop Sch.-II (or early in case of oil leakages) as per parameters given in RCF drawings, read alongwith FIAT specification no. 17.560.100. Dampers should be replaced during Shop Sch-III (6 years).

Damper	RCF Drg. No.	PL No.
Primary Vertical Damper	LW 05102	00920083
Secondary Vertical Damper	LW 05101	00920060
Secondary Lateral Damper	LW 05100	00920058
Yaw Damper	LW 05103	00920071

Bearings

- Rotate the bearing assembly to detect any abnormal condition. Check the bearing mounted end play. If end play is beyond permissible limit or if any roughness is detected while rotating the bearing, dismount the bearing and send for reconditioning.

NOTE:

1. *Bearing reconditioning is to be carried out whenever bearing is removed from axle due to wheel-shelling / bearing failure.*

2. *If new bearing or reconditioned bearing is fitted, a metal identification tag with the mounting date shall be crimped to the brake disc near the bearing.*

3. *If the wheelsets are sent for re-profiling without dismounting bearings, lubricate the lathe centres with heavy grease.*

4. *For reconditioning of bearings, please refer to OEM's instructions.*

Wheels and Axle

- Perform wheel profiling and wheel balancing (for Speed >= 130 Kmph). Refer to RCF specn.no. MDTS – 168 for balancing procedure.
- Perform a general overhaul of the axle, remove signs of corrosion, renew corrosion protection and repaint the axle.
- Check wear of wheels, if necessary, replace them.
- Perform an ultrasonic test on the wheel and axle to verify absence of internal cracks and damages.

Control Arm

- Perform a general overhaul of the control arm: remove signs of corrosion, renew corrosion protection and repaint the components.
- Check wear limit of control arm bore as follows; (Ref: RCF‟s letter no. MD 44121 Dt: 13.08.08)
  - If the control arm bearing surface reaches a diameter of 230.5 mm (i.e. wears out by more then 0.5 mm), the control arm should be considered worn out and rejected.
  - In case, the dia. is between 230.5 mm and 230.312 mm, the control arm may be re-machined by providing a cut of 0.3 to 0.5 mm on the face of control arm. (This machining operation should not be carried out more than once).
  - In case, the diameter is less than 230.312 mm, the control arm may be reused without remachining.
  - The control arm mating surface with bearing should be coated with " Blasol – 135" solution, to prevent corrosion.
  - Examine the rubber joint for cracks/damage and ageing. Replace, if necessary.

Bogie Frame and Bogie Bolster

- Examine the bogie frame and bolster for cracks, damages and corrosion. Check all the welded joints with dye penetration. If crakes are found, hold the bogie frame in a suitable manipulator, and rectify.
- Corroded bogie frames should be attended as follows:-
- Cleaning/washing of bogie frames.
- De-scaling/rust removal with rust converter to IS: 13515

- Touch-up with high build epoxy primer and paint as per RCF"s specification no. MDTS 166 (Rev.2) and MDTS 094.

NOTE: *Small pitting holes upto a maximum depth of 3 mm may be permitted on the frame, provided these are a) Staggered and non continuous b) Are not concentrated on the bottom bend portion of the side frame.(Ref: RCF's letter no.MD 44121 dt. 17.09.09)*

Anti-Roll Bar Assembly

- Perform a general overhaul of the anti-roll bar. Remove signs of corrosion, renew corrosion protection and repaint the anti-roll bar and the links
- Examine the condition of the brackets: remove signs of corrosion, renew corrosion protection and repaint the block.
- Replace fixings, rubber joints and sealings, on condition basis.
- Replace anti roll bar bearings, if necessary.

Traction Centre

- Perform a general overhaul of the traction centre components (Traction lever, Traction Rods). Remove signs of corrosion, renew corrosion protection and repaint the components.
- Replace the rubber bush and the rubber joints, if necessary.

Rotation Limiter

- Check condition of the steel roll and pin for wear/damages. Replace, if necessary.

Rubber and Rubber/Metal Bonded Parts

- Examine the Rubber and Rubber/Metal Bonded parts for ageing / damages/ failure of bonding. Replace, if necessary.

Bogie Pins

- Examine brake gear pins and other bogie pins for wear/ damages.
- Replace the pins with hard chrome plated pins as per RCF drawings.

NOTE: *RDSO has issued a check sheet for Bogie inspection of LHB coaches during SS-I & SS-II, vide letter no. SV.Fiat dated 14.03.2006.*

Further, western Railway has also issued a checklist for maintenance of LHB coaches in workshops, vide letter no. M442/19/4 (LHB) dated 23.11.2006, which may be referred by shops.

CBC

- Attend the Tight lock CBC as given in RDSO"s CMI no. RDSO/2006/CG/CMI -01

Under Frame & Running Gear

- Inspect trough floor- for corrosion and damage
- Inspect water tank frame- for corrosion and damage
- Inspect air brake module frame- for corrosion and damage
- Inspect air brake pipe lines- for corrosion and damage
- Inspect water system pipe line- for corrosion and damage
- Inspect emergency battery box frame- for corrosion, fixation bolt
- Inspect head stock for corrosion, damage
- Inspect sole bar for corrosion, damage.
- Inspect Gusset plate for corrosion, damage
- Inspect cross member for corrosion, damage

Water Supply

- Water tank tightening bolts- for tightness
- Water level Indicator - damage, leakage, working
- Rubber hose connection -replace of all rubber hose connection
- Drain cock protection cover - damage, availability
- Water inlet cover - provided
- Water tank sensor & its bracket -damage, broken

Roof

- Roof sheet- inspect for corrosion, damage, cracks
- Ventilator- inspect for corrosion, damage, deficiency of louvers
- Roof leakage- conduct leakage test

Exterior- Coach Body

- Window glasses, cracked, moist, opaque
- Window glasses rubber profiles
- Entrance doors out side rubber gaskets
- Destination board cover with locking arrangement , function of lock

- Entrance hand rails (body handles)- for tightness, condition of plating, cleanliness
- Foot steps – for corrosion, damage, fixation, tightness
- Ventilation grills of generator cars – for corrosion, damage, deficiency

Entrance Door (Main Door)

- Entrance door glass for cracked, moist, opaque, fixing with frame.
- Locking mechanism including locking cam top & locking pin bottom, universal lock, pad lock arrangement for working condition, damage, worn out, lubrication
- Locking handles for working condition
- Hand safe gasket for damage, worn-out
- Barrel Bolt(locking arrangement) for well positioned
- Entrance door, flap complete, panel, FRP cover, arm cylinder -Remove door flap in SS-II and fill up the gap by extending floor .
- Door stopper (All types)- Condition, deficiency
- Door Assembly -Proper alignment & working.

Luggage Door

- Top & Bottom Sliding Mechanism including guide rail, rollers, bearings, holding brackets, for working condition, worn, damaged
- Locking mechanism, for working condition
- Key locking arrangement, for working condition
- Rubber gasket , for damaged, worn out
- Door Flap Elements viz. Inner & outer locking handle, louvers, etc., for bent, broken or external damage.

Interior- Passenger Area

- Upholstery-condition of cushioning, rexene, leveling.
- Curtains (partition & window)-torn, stains
- Upper berth fenders- fixation, tightness
- PVC - aisle area-worn out, shabby look, torn.
- Snack table- cracks, damaged, shabby look, cleanliness
- Compartment mirror - dusty, cracked, de-silvering
- Magazine pocket
- Bottle holder
- Coat hooks
- Berth holder

- Luggage racks, luggage ropes
- Carpet (I class) - torn, stains, cleaned, dust free (replace if required)
- Locks of ceiling panels - working condition, lubrication
- Emergency window - working condition, availability of handles & instruction stickers.
- ICV pull Box
- All mandatory instructions stickers - availability in good condition

Saloon Sliding Doors

- Nylon wire rope -damaged, worn out
- S S wire rope- damaged, worn out
- Top mechanism including pneumatic cylinder - working condition, smooth working
- Guide shaft - lubrication by suitable lubricant.
- Locking mechanism - working condition
- Key locking arrangement - working condition
- Hand safe gasket - damaged, worn out
- Glass, glass film & rubber profiles - cleanliness, dusty, cracked
- Grill & grill rubber profiles
- Door flap elements viz. inner & outer locking handle, locking pin, moldings, rivets etc. - bent, broken or external damage

Doorway & Gangway Area

- Mirror (outside) - dusty, cracked.
- Wash basin/ FRP embedding- stainless steel or FRP (painted)
- Tap (gravity or auto sensor) - for working condition, leakage
- Dust bin with fire extinguisher stand - stainless steel or FRP(painted)
- Floor area(anti slip PVC or aluminum chequered plate) - worn-out, shabby look, tear off **.**
- Cup boards for linen and catering items - working condition, broken, damaged, availability of all fittings i.e. hinges, locks, stoppers etc.
- Attendant berth/seat - damaged, torn, broken, condition & securing of holding brackets
- Square key locks of ceiling panels - working condition, lubrication
- Leveling of ceiling panels
- Moldings, vestibule door cover, soap dish, securing brackets of fire extinguishers

Electrical Panel door

- Door elements like glass, glass gasket, door frame moulding, side & middle hinges, key locking arrangements- damaged, alignment, working condition

CDTS Panel Door

- Locking arrangement, hinges - working condition, lubrication

Lavatory Area

- Mirror (inside) - cracked, poor silver plating
- Wash basin - stainless steel or FRP painted, clean
- Tap (gravity tap / luxury tap) - working condition, leakage
- Soap dispenser - working condition, leakage
- Paper roller - loose, deficient
- Hopper window glass - condition of rubber, glass, operation of upper glass, locking arrangement of upper glass
- Dust bin - stainless steel or FRP(painted)
- Tube light column & its fittings -crack, broken, damaged
- 30 litre water tank - crack, broken, damaged, leakage, clean as per procedure given in RCF Manual
- Pipes, fittings, filters, timers (after opening ceiling panel) - crack, broken, damaged, leakage, clean as per procedure given in RCF Manual
- Painting of FRP panels.

Lavatory Door (Toilet Door)

- Guide roller channel - fixation, tightness, lubrication
- Guide roller channel - lubrication by suitable lubricant.
- Pivot (top) for fixation, tightness
- Pivot (bottom) for fixation, tightness
- Top roller for fixation, tightness, and lubrication.
- Middle hinges gasket for damaged, worn out
- Hand safe gasket for damaged, worn out
- Bottom grill for damaged, bent
- Barrel bolt (locking arrangement) including arrangement for toilet occupation indication., for working condition
- Provision of extra handles (inside) & existing handles & turn-over latches - damaged, missing**.**

- Coat hook - damaged, missing
- Door flap elements for bent, broken or external damage

Vestibule Sliding Door & Gang Bridge

- Nylon belt for damaged, worn out **.**
- Nylon/ steel wire rope for damaged, worn out
- Top mechanism including pneumatic cylinder for working condition, damage, defective
- Guide shaft - lubrication by suitable lubricant**.**
- Locking mechanism for working condition
- Key locking arrangement for working condition
- Male & Female hand safe gasket for damaged, worn out
- Glass & glass frame for cracked, opaque
- Door flap elements viz. inner & outer locking handle, locking pin, moldings, rivets etc. for bent, broken or external damage
- Gangway bridge (vestibule foot) plate including roller, channel, spring, fasteners for damaged, working mechanism / condition
- Vestibule foot plate pin for wear, damage
- Vestibule foot plate split pin for wear, damage**.**
- Vestibule Rubber for crack, damage**.**

12.6 SHOP SCHEDULE-II (36 MONTHS)

In addition to the activities listed under Shop Schedule-I, the following activities shall be carried out in Shop Schedule-II.

Brake Equipment

- Perform *overhauling* and function test of the brake system components:
  - Distributor valve
  - Check valve
  - Isolating cocks/angle cocks
  - Filters, indicators, test fittings.
  - Emergency brake valve & pull box
  - Brake cylinders
  - WSP equipment
- Replace brake gear pins and other bogie pins/bushes.
- Replace Air Brake Hoses

Bogie Frame and Bogie Bolster

- Check the dimensional and geometrical tolerances of bogie frame as per FIAT drg. No. 1267505. Rectify/replace as necessary.
- The complete bogie frame should be cleaned (with scrapping/shot blasting) and painted with high built epoxy primer and paint as per RCF specification no. MDTS 166 (Rev.2) and MDTS – 094, with a minimum DFT of 200 microns.

NOTE*: Small pitting holes upto a maximum depth of 3 mm may be permitted on the frame, provided these are a) staggered and non continuous b) Are not concentrated on the bottom bend portion of the side frame.*

Bearings

- Dismount the Bearings and send for inspection/reconditioning.

Anti-Roll Bar Assembly

- Perform overhaul of the anti-roll bar. Repair/replace the defective/worn out components.
- Replace all rubber joints, sealings and anti roll bar bearings .

Traction Centre

- Perform a general overhaul of the traction lever.
- Replace the rubber bush and the rubber joints .

Rubber and Rubber / Metal Bonded Parts

- Replace all the rubber and rubber/metal bonded parts as must change item.

Under Frame & Running Gear

- Inspect head stock for corrosion, damage
- Inspect sole bar for corrosion, damage.
- Inspect Gusset plate for corrosion, damage
- Inspect cross member for corrosion, damage

Water Supply

- Water tank and water supply pipe line- cleaning as per procedure given in RCF maintenance manual.
- Pressure testing

Exterior- Coach Body

- Condition of exterior paint for peeling off, loss of gloss, scratches
- Exterior body check for corrosion, damage

Entrance Door (Main Door)

- Pivot (top) for working condition
- Pivot (bottom) for working condition

Complete overhauling of main doors/Vestibules doors/sliding doors and Lavatory doors.

Interior- Passenger Area

- FRP panels including ceiling panels for cracks, damaged, condition of paint, shabby look (clean by soap water), and follow repair guidelines circulated by RCF.
- PVC (inside the compartment) for worn out, shabby look, torn
- Ladder - condition, painting.
- Non upgraded PVC flooring should be replaced.

Electrical Panel door

- Switch board doors - Replace FRP doors by better FRP.

CDTS Panel Door

- CDTS panel door - Replace FRP doors by better design FRP.

Lavatory Area

- FRP panels (Ref. RCF guidelines) - cracks, damaged, condition of paint, shabby look (clean by soap water) apply putty & paint the FRP panels

Furnishings

- 100% replacement of Rexine.
- 100% replacement of carpets of Exec. Chair car, thereafter, carpet is to be provided in Aisle portion only as per extant instructions.

12.7 SHOP SCHEDULE-III (72 MONTHS)

In addition to the activities listed under Shop Sch.-I and Shop Sch-II, the following activities shall be carried out in Shop Sch-III.

Dampers

- Replace all dampers during Shop Schedule-III.

CBC

- Dismount the CBC from coach, disassembled and overhauled as given in RDSO"s CMI no. RDSO/2006/CG/CMI-01

Interior- Passenger Area

- Replacement of up graded specification PVC flooring.

12.8 MUST CHANGE ITEMS DURING SHOP SCHEDULE –II

List of must change items during Shop Schedule –II is enclosed as Annexure "12.6"

12.9 TOOL AND EQUIPMENTS

Tools and Equipments for maintenance of FIAT bogie are given as Annexure "12.7" and Tools and equipments for Depot maintenance and traveling TXR are given in Annexure 12.8.

12.10 RUBBER AND WEAR PARTS

The major rubber and wear parts of FIAT bogie are:

- Rubber bush for traction centre
- Rubber joint for control arm
- Elastic joint for traction rods
- Joints for anti roll bar
- Longitudinal bump stops
- Lateral bump stops
- Rubber disc and bump stop for primary suspension
- Rubber ring and rubber spring for secondary suspension

Examine all rubber and wear parts for external condition, cracks, detachment between rubber & metal, and permanent set during shop schedule-I. Replace, if necessary.

12.11 PRIMARY & SECONDARY SPRINGS

The primary & secondary suspension springs used in various LHB coaches are given as follows:-

Primary Suspension Springs

Coach type	INNER (Drg.No.)	OUTER (Drg.No.)
AC-Chair car Ist & 2nd	1267412	1267411
ACCN/EOG	1277143	1267411
ACCW/EOG	1267412	1267411
FAC/EOG	1267412	1267411
Hot buffet car	1267412	1267411
Power Car	1277143	1277142

Secondary Suspension Springs

	INNER(Drg.No.)		OUTER(Drg.No.)	
AC-Chair car Ist & 2nd	1269513		1269514	
ACCN/EOG	1269513		1268836	
ACCW/EOG	1269513		1269514	
FAC/EOG	1269513		1269514	
Hot buffet car	1269513		1269514	
Power Car	Side 1	Side 2	Side 1	Side 2
	1277145	1268837	1277146	1268836

Coupling and Installation Instruction for Flexi Coil Secondary Springs

Please refer to FIAT-SIG technical specification No. 17.471, part document 101, version 01 for coupling and installation instructions of flexi coil secondary springs.

Colour Coding of springs for Identification

For identification of springs to be used in different types of LHB Coaches, middle coil of the primary & secondary springs to be painted with compatible paint of springs in different colours indicated against each group as shown below:
(Ref: RCF"s letter no. MD 23151 dt. 23.11.2002)

Primary Springs		**Secondary springs**		**Paint colour to be painted on middle coil**
Inner	**Outer**	**Inner**	**Outer**	
1267412	1267411	1269513	1269514	Green
1277143	1277142	1268837	1268836	Yellow
---	---	1277145	1277146	Blue
LG01101	LG01100	LG05100	LG05101	Black

The paint should be compatible with the paint of spring as specified in clause 8.3 of specification no. 17.248.100 version 05.

Maintenance of springs

Primary & secondary springs are protected against corrosion by a paint coating. This surface protection should remain undamaged, otherwise there can be local corrosion attack, resulting in spring failures.

Trip Schedule (D1)

Carry out visual inspection of springs for damages, corrosion, cracks or broken springs.

Monthly Schedule (D2)

Same as Trip schedule**.**

Half Yearly Schedule (D3)

Same as Trip schedule

Shop Schedule I, II (18 Months/36 Months)

- Clean the primary/ secondary springs thoroughly (with suitable detergent water jet) in disassembled condition.
- Inspect visually for any cracks, damages, corrosion and breakage.
- Any damage to coating may be repaired by primer and high build epoxy paint to RCF specification.
- If rust is visible, derust with the steel brush, and repair the coating as given above.
- In case of corrosion –pitting, cracks or breakage, replace the spring.

Shop Schedule – III (72 Months)

In addition to activities given under Shop Schedule –I, carry out the following-

- Testing of springs for free height (permanent set)
- Testing of spring for load/deflection characteristics as given in drawings and specification no. 17.248.100.
- Replace the spring, if free height/deflection is beyond permissible limits.

ANNEXURE 12.1

CHECK LIST OF COMPONENT OF BOGIE IN SHOP SCHEDULES (SS-1, SS-2 &SS-3)

Coach No.		**Code:**		**Date:**							
S. No.	**Description & location of Nut & Bolt**	**Nut-Bolt Size**	**Torque Value**	**"Leading Trolley Left Side" (LTLS)**		**"Leading Trolley Right side(LTRS)**		**"Trailing Trolley Left side"(TTLS)**		**"Trailing Trolley Right side"(TTRS)**	
1	Traction Centre Pin nut tighten	M16X70	170 Nm	Done/Not done				Done/Not done			
2	Traction Centre pin Lock plate bending			Done/Not done				Done/Not done			
3	Wire rope spilt pin										
4	Lateral Damper Nut Bolt tighten	M12X55	70 Nm	**NA**				**NA**			
5	Bolt between Vertical Rod and anti roll bar	M24	590 Nm								
6	Traction Rod Nut	M24X120	590 Nm								
7	Traction Rod/Traction lever link bolt	M24X200	590 Nm								
8	Lateral Bump Stop Nut/bolt	M16X100	170 Nm								
9	Bump Stop at Bolster nut/bolt	M8X50	21 Nm								
10	Shims at bolster bump stop nos.	Bolt fitted standard Or non standard		5mm X 10mm X		5mm X 10mm X		5mm X 10mm X		5mm X 10mm X	
11	Bolt between Anti roll bar to fixing block	M16X160	170 Nm								
12	Vertical Damper fitted at Sec. Susp.	M12X100	70 Nm	Serviceable/New Tested		Serviceable/New Tested		Serviceable/New Tested		Serviceable/New Tested	
13	Yaw Damper nut	M16X120	170 Nm	Serviceable/New Tested		Serviceable/New Tested		Serviceable/New Tested		Serviceable/New Tested	
14	Vertical Damper fitted at Primary Susp.	M12X100	70 Nm	NEW SERVICABLE Tested	NEW SERVICABLE Tested	NEW SERVICABLE Tested	NEW SERVICABLE Tested	NEW SERVICABLE Tested	NEW SERVICABLE Tested	NEW SERVICABLE Tested	NEW SERVICABLE Tested
15	Corner Roller split pin										
16	Car body nut bogie	M30	700 Nm								

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Coach No.		**Code:**		**Date:**							
S. No.	**Description & location of Nut & Bolt**	**Nut-Bolt Size**	**Torque Value**	**"Leading Trolley Left Side" (LTLS)**		**"Leading Trolley Right side(LTRS)**		**"Trailing Trolley Left side"(TTLS)**		**"Trailing Trolley Right side"(TTRS)**	
17	Car body nut bogie spilt pin										
18	Car body lateral pin, spilt pin										
19	Control Arm housing Nut bolt	M16X70	170 Nm								
20	Axle box front cover	M16X45	170 Nm								
21	Control Arm lug safety pin (splitted)										
22	Control Arm Bkt at bogie bolt	M20X100	170 Nm								
23	Adjusting shims nos.	Plate thickness 5mm									
24	Resistance			NA				NA			
25	Resistance Cable			NA				NA			
26	Ground cable			Provided/ not provided		**NA**		Provided/ not provided		**NA**	
27	Ground cable bolt/nut	M10X16	40 Nm	Fitted/ Not Fitted		**NA**		Fitted/ Not Fitted		**NA**	
28	Earth cable			Provided/ not provided		**NA**		Provided/ not provided		**NA**	
29	Earth cable bolt/nut	M16X45	170 Nm	Fitted/Not Fitted		**NA**		Fitted/Not Fitted		**NA**	
30	Speed Sensor Cable			**NA**		Provided/ Not provided	Provided/ Not provided	**NA**		Provided/ Not provided	Provided/ Not provided
31	Axle box with current return device	NEW SERVICEABLE		Provided/ not provided		**NA**		Provided/ not provided		**NA**	
32	Axle box with antiskid sensor WSP			**NA**		Provided/ not provided		**NA**		Provided/ not provided	
33	Axle box with no sensor			Provided/ not provided		**NA**		Provided/ not provided		**NA**	
34	Traction Centre support	M20X100	340 Nm								

Coach No.		Code:		Date:							
S. No.	**Description & location of Nut & Bolt**	**Nut-Bolt Size**	**Torque Value**	**"Leading Trolley Left Side" (LTLS)**		**"Leading Trolley Right side(LTRS)**		**"Trailing Trolley Left side"(TTLS)**		**"Trailing Trolley Right side"(TTRS)**	
	frame to Bogie cross beam										
35	Traction rod S/Bloc			NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE
36	Lateral bump stop			NEW SERVICEABLE		NEW SERVICEABLE		NEW SERVICEABLE		NEW SERVICEABLE	
37	Traction lever S /bloc			NEW SERVICEABLE				NEW SERVICEABLE			
38	Control Arm S/bloc			NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE
39	Pri. Sus. Upp. Disc Bump stop			NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE
40	Ver. Rod S/bloc			NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE	NEW SERVICABLE
1	Rubber Spring			NEW SERVICEABLE		NEW SERVICEABLE		NEW SERVICEABLE		NEW SERVICEABLE	

ANNEXURE 12.2

INSPECTION SHEET FOR LHB COACH BOGIE FOR SHOP SCHEDULE SS-1, SS-2 & SS-3

Coach No. Trans code Year Built- Leading Bogie No- Trailing Bogie No.										
S.NO.	**DESCRIPTION**	**DESIGN VALUE UNDER TARE**	**Leading Bogie**				**Trailing Bogie**			
1	Wheel Diameter	**Max-915 Min-845**	1	8	2	7	3	6	4	5
2	Wheel Barrel No.									
3	Clearance between brake disc bottom to Rail Level	**137.5mm**								
4	Clearance between bolster beam upper spring seat from bottom surface to top surface of bottom spring seat (Bolster Spring Height)	**517mm**								
5	Height of Bogie frame top from Rail level.	**925+0/-5 mm**								
6	Height of Bogie Bolster base plate (machined surface) from Rail level.	**1. 930+6/-2 mm 2. Less than or equal to 4mm**								
7	Clearance between Secondary Vertical Bump stop gap	**90 to 95mm**								
8 (*)	Axle box to bogie frame (Primary spring height)	**260+0/-4mmG.car 252+0/-4mmG.car**								
9	Clearance between safety pin & lug of control arm(Top/Bottom)	**Top= 45 mm**								
		Bottom= 37.5 mm								
10	Clearance between Lateral Bump Stop and Traction Centre	**25mm+5/-2**								
11	Clearance between Longitudinal bump stop and traction centre	**8mm+5/-2**								

Coach No.	**Trans code**	**Year Built-**	**Leading Bogie No-**		**Trailing Bogie No.**	
12(*)	Clearance between Primary Vertical Bump stop Gap	**08mm Gen. Car**				
13	Max No. of shims at Vertical bump stop 1. Metal Shim (05mm) 2. Synthetic (10mm)	**No limit of packing (the length of bolts used to secure it)**	**Metal shims :** **Synthetic Shims :**	**Metal shims :** **Synthetic Shims :**	**Metal shims :** **Synthetic Shims :**	**Metal shims :** **Synthetic Shims :**
14	CBC height	**1090 to 1105mm**				
15	Max No. of Shims at body bogie connection 1. Metal shims=05mm	**Max (11nos.)**				
16(*)	Rail level to the control arm bracket (vary depending upon wheel dia)	**1. 459±4mmG.side 1 464±4mmG.side2** **2. Less than equal to 3mm**				
17	Height from top plate of side frame to upper face of spring seat	**1.44±2 mm** **2. Less than equal to 6mm**				
18	Earthing lead provided or not	**Yes/No**				
19	Security Rope	**467 +1/-2mm**	new/ serviceable	new/ serviceable	new/ serviceable	new/ serviceable

(*) Dimension only for Power Car

ANNEXURE 12.3

ITEMS OF WORK TO BE COVERED UNDER PERIODIC SCHEDULES OF DOORS			
VESTIBULE DOORS			
Sr. No.	**ITEM**	**SS-I**	**SS-II**
1	Check the automatic mechanism of door for smooth functioning.	C	M
2	Check all the elements of door mechanism for good condition and working like Shaft, pneumatic cylinder, LM bearings, elastic rope toothed belt, mountings and brackets	C	M
3	Dismantle the mechanism if not working smoothly and replace or repair the defective element.	C	C
4	Reassemble the mechanism and check for proper working.	C	C
5	Check the door flaps for bent, broken or externally damage and repair or replace the defective door flap.	C	C
6	Check the door flap element like inner & outer locking handle, locking pin, glass and glass frame, male & female hand safe gasket, moldings, mountings, rivets etc. for bent, broken or externally damage and repair or replace the defective element of door flap.	C	M
7	Check the guide rail for bent, corroded & damage. Repair or replace if required.	C	C
8	Check the Key locking arrangement for good condition and working.	C	C
9	Provide suitable lubricate on guide shaft for smooth working.	C	M
	SLIDING DOORS		
1	Check the automatic mechanism of door for smooth functioning.	C	M
2	Check all the elements of door mechanism for good condition and working like Shaft, pneumatic cylinder, LM bearings, elastic rope, mountings and brackets	C	M
3	Dismantle the mechanism if not working smoothly and replace or repair the defective element.	C	C
4	Reassemble the mechanism and check for proper working.	C	C
5	Check the door for bent, broken or externally damage and repair or replace the defective door.	C	C
6	Check the door element like inner & outer handle, glass and glass rubber profile, hand safe gasket, moldings, mountings ,rivets etc. for bent, broken or externally damage and repair or replace the defective element of door.	C	M
7	Check the ventilation grill for intact and good condition.	C	C
8	Check the Key locking arrangement and barrel bolt for good condition and working.	C	C
9	Provide suitable lubricate on guide shaft for smooth working.	C	M

Sr. No.	ITEM	SS-I	SS-II
	TOILET DOORS		
1	Check the door for bent, broken or externally damage and repair or replace the defective door.	C	C
2	Check the door element like inner & outer handle, hand safe gasket, middle hinge gasket, door frame moldings, upper & lower pivot, roller assembly, rivets etc. for bent, broken or externally damage and repair or replace the defective element of door.	C	M
3	Check the roller guide for bent, corroded, damage or loose fitted. Repair or replace if found defective and ensure for correct fitting and secured firmly.	C	C
4	Check carefully the door locking arrangement for smooth working and ensure upper connecting rod is working properly. If found defective disassemble the door , take out the lock assembly and repair or replace the defective element/ lock assembly.	C	M
5	Check the housing (FRP panel) of upper pivot for damage, broken or loose fitted. If found repair with good ideas and tighten the screws of upper pivot plate.	C	C
6	Check the all other fittings like Inside extra handle, coat hook and barrel bolt are in good condition and secured properly.	C	M
7	If the doors are provided with slide lock and turn over latch , check the condition of sliding rod for bent or damage and turn over latch for bent, broken or damage and replace the defective parts.	C	M
8	Provide suitable lubricate on roller guide for smooth working.	C	M
	ENTRANCE DOOR		
1	Check the door for bent, broken, shifting of outer sheet or externally damage. If found repair or replace the defective door.	C	C
2	Check the door element like inner & outer handle, hand safe gasket, facing brick gasket, outer gasket, door frame moldings, upper & lower pivot, rivets etc. for bent, broken or externally damage, repair or replace the defective element of door.	C	C
3	Check carefully the door locking arrangement for smooth working and ensure upper & lower connecting rod is working properly. If found defective, disassemble the inner handle & cover of locking assembly and repair or replace the defective element/ lock assembly.	C	C
4	Check the all other fittings like lower lock mounting, upper lock stopper, Nylon door stopper and barrel bolt are in good condition and secured properly.	C	C

Sr. No.	ITEM	SS-I	SS-II
5	If the doors are provided with flap, check the condition of arm cylinder, stopper, flap and door panel for bent, damage or broken, repair or replace the defective parts. Note: Remove door flap in 1st POH and fill up the gap by extending floor.	C	M
6	If the window glass of door is found broken or cracked , change the glass as per procedure.	C	M
7	Repaint the doors from inside and out side.	C	C
	ELECTRICAL PANEL DOOR		
1	Check the door for bent, broken, shifting or damage. If found repair or replace the defective door.	C	M
2	Check the door element like glass, glass gasket, door frame moldings, side & middle hinge, Key locking arrangement etc. for broken or damage. If found repair or replace the defective element of door.	C	C
	CDTS PANEL DOOR		
1	Check the door for broken, shifting or damage. If found repair or replace the defective door.	C	M
2	Check the hinges and Key locking arrangement for corroded & damage and replace the defective one.	C	C
3	Check the lock holder for missing, loose fitted and provide or refitted the lock holder and remove the screws form the doors if provided	C	C
4	Repaint the doors from out side.	C	C
NOTE	**M- MUST BE ATTENDED** **C- TO BE ATTENDED ON CONDITION BASIS**		

ANNEXURE 12.4

INSPECTION CHECK SHEET FOR SS-I / SS-II OF LHB COACHES

S. NO	WORK TO BE INSPECTED	CRITERIA TO BE CHECKED & ATTENDED	PERIODICITY	
			SS-I	SS-II
1	**EXTERIOR BODY**			
	Condition of exterior paint	Peeling off, dullness, scratches	-	M
	Exterior Body	Corrosion, Damage	-	C
	Window glasses	Cracked, dusty	C	C
	Window glasses Rubber Profiles	Condition	C	M
	Entrance doors out side Rubber Gaskets	Condition	C	M
	Destination Board Cover with locking arrangement	Damaged, Function of Lock, cleaned	C	C
	Entrance Hand Rails (Body handles)	Tightness, Condition of plating, cleanliness	C	C
	Foot steps	Corrosion, Damage, Fixation, Tightness	C	C
2	**INTERIOR OF COACH**			
	FRP Panels	Cracks, damaged, Condition of Paint, Shabby look (clean by soap water)	-	C
		Apply putty & paint the FRP Panels	-	M
	Upholstery	Condition of cushioning, rexine, levelling	C	M
	Curtains (Partition & Window)	Torn, stains	C	M
	Upper Berth Fenders	Fixation, Tightness	C	C
	PVC - Inside the compartment	Worn out, shabby look, torn	-	C
	PVC - Aisle area	Worn out, shabby look, torn	C	M
	Snack Table	Cracks, damaged, Shabby look, Cleanliness	C	C
	Compartment mirror	Dusty, cracked, de-silvering	C	C
	Magazine Pocket	Condition	C	C
	Bottle Holder	Condition	C	C
	Coat Hooks	Condition	C	C

S. NO	WORK TO BE INSPECTED	CRITERIA TO BE CHECKED & ATTENDED	PERIODICITY	
			SS-I	SS-II
	Ladder	Painting	-	M
	Carpet (I Class)	Torn, stains, cleaned, dust free (Replace if required)	-	C
3	**SALOON SLIDING DOORS**			
	Nylon Wire rope	Damaged, worn out	C	C
	S S Wire rope	Damaged, worn out	C	C
	Top Mechanism	Working condition, smooth working	C	C
	Locking mechanism	Working condition	C	C
	Glass & Rubber profiles	Cleanliness, dusty, cracked	C	C
	Grill & Grill rubber profiles	Condition	C	C
4	**UNDER FRAME**			
	Head Stock	Corrosion, Damage	-	C
	Sole Bar	Corrosion, Damage	-	C
	Guset Plate	Corrosion, Damage	-	C
	Cross Members	Corrosion, Damage	-	C
	Water Tank Frame	Corrosion, Damage, tight nut bolt	C	C
	Air brake Module frame	Corrosion, Damage, tight nut bolt	C	C
	Air brake pipe lines	Corrosion, Damage, clamp tightening	C	C
	Water system pipe line	Corrosion, Damage, clamp tightening	C	C
	Emergency Battery Box Frame	Corrosion, Fixation Bolt	C	C
5	**WATER TANK**			
	Pressure testing	**At 4.5 Kg/cm^2 / (9 POUND)**	-	M
	Water tank tighting bolts	Tightness	-	M
	Water level Indicator	Damage, Leakage	-	C
	Rubber hose connection	Replace of all Rubber hose connection	-	M
	Drain Cock	Deficient, repair & refit	-	M
	Drain Cock Protection Cover	New provided	C	C
	Water inlet Cover	Provided	-	C

S. NO	WORK TO BE INSPECTED	CRITERIA TO BE CHECKED & ATTENDED	PERIODICITY	
			SS-I	SS-II
6	**DOORWAY AREAS**			
	Mirror (Outside)	Dusty, Cracked	C	M
	Wash basin	Stainless Steel or FRP (Painted)	C	C
	Tap (Gravity or Auto sensor)	Working condition, leakage	C	C
	Dust Bin with Fire extinguisher Stand	Stainless Steel or FRP(Painted)	C	C
	Floor area(Anti slip PVC or Aluminium chequered plate)	Wornout, shabby look, tear off	C	M
	CDTS Control Panel Cover	Repaired old FRP OR New sun mica Type.	-	C
	Switch Board Doors	Repaired old FRP OR New sun mica Type.	-	C
7	**ENTRANCE DOOR**			
	Entrance Door Glass	Dusty, Cracked	C	C
	Locking mechanism	Working condition	C	C
	Locking handles	Working condition	C	C
	Pivot (Top)	Working condition	-	C
	Pivot (Bottom)	Working condition	-	C
	Rubber Profile (End)	Well positioned	C	M
	Barrel Bolt(Locking arrangement)	Well positioned	C	C
8	**LAVATORY**			
	Mirror (Inside)	Dusty, Cracked,	C	C
	Wash basin	Stainless steel or FRP Painted, Clean	C	C
	Tap (Gravity tap / Luxury tap)	Working condition, Leakage	C	C
	Soap Dispenser	Working condition, Leakage	C	C
	Paper roller	Loose, deficient	C	C
	Hopper Window Glass	Condition of Rubber, Glass, Operation of Upper Glass, Locking arrangement of Upper Glass	C	C

S. NO	WORK TO BE INSPECTED	CRITERIA TO BE CHECKED & ATTENDED	PERIODICITY	
			SS-I	SS-II
	Dust Bin	Stainless Steel or FRP(Painted)	C	C
	FRP Panels	Cracks, damaged, Condition of Paint, Shabby look (clean by soap water)	-	C
		Apply putty & paint the FRP Panels	-	M
9	**LAVATORY DOOR**			
	Guide Roller Channel	Fixation, tightness	C	C
	Pivot (Top)	Fixation, tightness	C	C
	Pivot (Bottom)	Fixation, tightness	C	C
	Top Roller	Fixation, tightness	C	M
	Rubber Profile (Middle)		C	M
	Rubber Profile (End)		C	M
	Bottom Grill		C	C
	Barrel Bolt (Locking arrangement)		C	C
10	**VESTIBULE SLIDING DOOR & Gangway Bridge**			
	Nylon Belt	Damaged, worn out	C	M
	Nylon Wire rope	Damaged, worn out	C	C
	M S Wire rope	Damaged, worn out	C	C
	Top Mechanism	Working condition, smooth working	C	C
	Locking mechanism	Working condition	C	C
	Glass	Cleanliness, dusty, cracked	C	C
	Gangway bridge (Vestibule Foot) Plate	Damaged, working condition / mechanism	C	C
	Vestibule Foot Plate Pin	Wear, damage	C	M
NOTE	**M - MUST BE ATTENDED**			
	C - TO BE ATTENDED ON CONDITION BASIS			

ANNEXURE 12.5

MAINTENANCE SCHEDULES FOR LHB COACH

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
1.0	**Coach:**			
1.1	Coach should be washed both from out side & inside.	√	√	√
1.2	Disinfect and spray insecticide at corner and crevices of coaches after washing all the coaches **(AC Coach & Pantry Car – 15 Days)**	-	√	√
1.3	Intensive cleaning of coach panels, chequered plates and PVC floor.	-	√	√
2.0	**Coach Shell**			
2.1	Visually check body panels/end walls for damages	√	√	√
2.2	Visually inspect destination boards brackets.	√	√	√
2.3	Visually inspect window glass and rubber sealing for damage/missing.	√	√	√
2.4	Examine body side doors for working/ damages	√	√	√
2.5	Inspect door handles for damages/missing	√	√	√
2.6	Inspect vestibule and its Rubber fittings for damages/missing, repair if necessary.	√	√	√
2.7	Visually check vestibule fall plates, mounting brackets, pins and operation of sliding doors and its lock lever for ease of	√	√	√

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
	operation, damages/ deficiency.			
2.8	Thoroughly clean and remove dust, dirt accumulated at pillars with coir brush.	-	-	√
2.9	Examine for corrosion of sole bar and other under frame members with torch light or inspection hand lamp	-	-	√
2.10	Touch up damaged paint both inside & outside	-	-	√
2.11	Check roof ventilator in Non AC for damages/defects.	-	-	√
3.0	**BOGIE & AIR BRAKE**			
	Bogie Frame and Bolster Assembly			
3.1	Perform a visual check on longitudinal beams, cross beams & bolster for cracks, damages and for corrosion.	√	√	√
3.2	Perform a visual check on brake supports, damper supports, traction centre supports and anti-roll bar supports for cracks, damages and for corrosion.	√	√	√
3.3	Check bogie bolster sub assembly and brackets for cracks, damages and corrosion.	√	√	√
3.4	Wash the bogie frame thoroughly with water jet, making sure that water is not directed towards pneumatic / elect. Connections and axle bearings.	-	√	√
3.5	Examine the bogie frame for corrosion / damages, especially at critical locations like lower web, yaw damper bracket etc..	-	-	√
3.6	Carry out paint touch up as per RCF specifications MDTS – 166.	-	-	√

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
4.0	**Brake Equipments**			
4.1	Check functionality of air brake equipment and (Hand brake equipment in LWLRRM).	√	√	√
4.2	Perform a visual check on Brake cylinders/ brake levers and Hand brake equipment in LWLRRM for damage, cracks and corrosion.	√	√	√
4.3	Perform a functional test on pneumatic brake system. Make sure that no air leaks are present.	√	√	√
4.4	Perform a visual check on all air hoses.	√	√	√
4.5	Visually inspect steel piping for cracks/ damages/ ballast hitting. Repair/ replace if necessary.	√	√	√
4.6	Perform a visual check on brake discs for cracks on face, fins, hub etc.	-	√	√
4.7	Verify that the clearance between each brake pad and disc surface is 1-1.5 mm.	-	√	√
4.8	Check wear of brake pads/ brake discs.	√	√	√
4.9	Lubricate the brake levers, fixings and all moving parts.	-	√	√
5.0	**Wheel slide Protection**			
5.1	Perform a visual check on all grounding cables & WSP equipment cables for breaks/ damages.	√	√	√

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
5.2	Visually check equipment like front axle cover & upper & lower control arms for any damages, cracks, and corrosion marks.	√	√	√
5.3	Check functioning of WSP equipments (in WSP panel & its codes).	√	√	√
5.4	Inspect the Earthing equipment for wear of slip assembly / carbon bars.	-	√	√
5.5	Monthly / Quarterly inspection of WSP equipment to be carried out as per schedule	-	√	√
5.6	Check speed sensor gap	-	-	√
6.0	**Primary & Secondary Suspension**			
6.1	Visually check primary springs for cracks & damages.	√	√	√
6.2	Visually check safety wire ropes between bogie frame and bogie bolster for damages, and corrosion.	√	√	√
7.0	**Primary/Secondary/Yaw dampers**			
7.1	Perform a visual check on dampers for damage, cracks and oil leaks.	√	√	√
7.2	Perform a visual check on all fixings for loosening and/or	√	√	√

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
	missing components			
7.3	Perform a visual check on rubber elements for cracks and ageing.	√	√	√
8.0	**Bearings (CTRB/TBU)**			
8.1	Carry out bearing feeling for detection of hot bearing. (During rolling in Examination)	√	√	√
9.0	**Wheel & Axle**			
9.1	Perform a visual check on wheels for cracks	√	√	√
9.2	Check by wheel profile gauge	--	√	√
9.3	Check axle for cracks and signs of corrosion	√	√	√
9.4	Check tread diameter and wear of wheel profile. If necessary, perform re-profiling.	-	√	√
9.5	Check wheels offset on axle (1600 ±1 mm)	-	-	√
10.0	**Control Arm**			
10.1	Perform a visual check on all fixings for loosening and / or missing components	√	√	√

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
10.2	Visually check control arm parts for damages, cracks or corrosion marks.	√	√	√
10.3	Inspect the rubber joints for damages and ageing.	--	--	√
11.0	**Anti Roll bar Assembly**			
11.1	Perform a visual check on Anti roll bar, links and Brackets for cracks, damages and corrosion.	√	√	√
11.2	Perform a visual check on rubber joints for cracks, damage and ageing.	-	-	√
11.3	Visually inspect for grease oozing out of anti roll bar bearings, which may result in bearing failure.	√	√	√
11.4	Perform visual check on all fixing for loosening/missing fittings.	√	√	√
12.0	**Traction Centre**			
12.1	Perform a visual check on the traction centre lever and on the rods for cracks, damages and corrosion.	√	√	√
12.2	The assembly should be free to move, and not blocked by any foreign objects.	√	√	√

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
12.3	Perform a visual check on all fixings for loosening.	√	√	√
12.4	Perform a visual check on rubber joints for cracks/damages.	√	√	√
12.5	Greasing of anti roll-bar		√	√
13.0	**Rotation Limiter**			
13.1	Perform a visual check of rotation limiter, components	√	√	√
14.0	**Rubber and Rubber/Metal Bonded parts**			
14.1	Perform a visual check on Rubber and Rubber/Metal bonded parts for cracks, damages and ageing.	-	√	√
15.0	**Pins and bushes**			
15.1	Lubricate all pins and Bushes.	-	√	√
16.0	**Body works -**			
16.1	General inspection of Vehicle body work (paint work, glazing etc).	-	√	√
17.0	**Draw & Buffing Gears -** **(Ref: CMI No: RDSO/2006/CG/CMI/01 Rev No: Nil)**			
17.1	Visual Inspection of Tight lock coupler head for damage.	√	√	√
17.2	Visual Inspection of Knuckle for damage.	-	-	√
17.3	Checking of coupler operating mechanism for damage, loose, bolts etc.	√	√	√
17.4	Greasing of Slide rod of coupler operating mechanism.	-	√	√
17.5	Checking tell tale recess for ensuring proper coupling.	√	√	√
17.6	Inspection of coupler carriers/supporting device & its spring	√	√	√

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
	for cracks & breakage			
17.7	Inspection of loose/broken/missing nuts & bolts (M-16) of coupler pin support plate & draft gear support plate.	√	√	√
18.0	**Corridor Connections -**			
18.1	Check corridor connections for external damage & foreign bodies.	√	√	√
18.2	Check vestibule connection for external damage & foreign bodies.	√	√	√
19.0	**Air Pressure Equipment**			
19.1	Dry out air - filter	-	√	√
19.2	Clean air - filter	-	√	√
19.3	Clean airline - filter	-	√	√
19.4	Drain air Reservoirs.	√	√	√
20.0	**Interior fitting passenger accommodation-**		√	
20.1	General visual check for damage	√	√	√
20.2	Check for regulation provision in dust bins & operational fire extinguishers.	√	√	√
20.3	Check hand rails, sliding doors, shutters, toilet doors, vestibule doors and their functioning.	√	√	√
20.4	Check bath room fittings visually	√	√	√
20.5	Clean top & bottom guide rails of luggage doors of power	√	√	

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
	cars & greasing of guide bearing.			
20.6	Inspect seats & check for completeness.	-	√	√
20.7	Inspect luggage racks & check for completeness.	-	√	√
20.8	Check all hand-rails manually for correct fitment & fixing.	-	√	√
20.9	Inspect PVC floors and chequered plates for any damage.	-	√	√
20.10	Checks stick-on notices and directions for condition & completeness.	-	√	√
20.11	Check single Leaf sliding door - general function & ease of movement.	√	√	√
20.12	Check double leaf connection door - general function & ease of movement.	√	√	√
21.0	**Passenger Doors**			
21.1	Check General functions of passenger doors for ease of movement	√	√	√
21.2	Lubricate door seals	-	-	√
21.3	Clean & lubricate door mechanisms.	-	√	√
22.0	**Water supply system -**			
22.1	Check tanks pipes for leakage.	√	√	√
22.2	Check tank mountings brackets and fittings.	√	√	√
22.3	Rinsing the pipes & water tanks	-	√	√
23.0	**Pantry**			
23.1	Check for damages & deficiencies in the pantry construction,	√	√	√

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
	fittings, water supply & drainage of the pantry area.			
24.0	**Sanitary Equipments**			
24.1	Check functioning of toilet system.	√	√	√

MAINTENANCE SCHEDULES OF DOUBLE DECKER COACH

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
1.0	**Double Decker Coach:**			
1.1	Coach should be washed both from out side & inside.	√	√	√
1.2	Disinfect and spray insecticide at corner and crevices of coaches after washing all the coaches (AC Coach & Pantry Car – 15 Days)	-	√	√
1.3	Intensive cleaning of double decker coach panels, chequered plates and PVC floor in lower & upper deck.	-	√	√
2.0	**Coach Shell**			
2.1	Visually check body panels/end walls for damages	√	√	√
2.2	Visually inspect destination boards brackets.	√	√	√
2.3	Visually inspect window glass and rubber sealing of lower & upper deck for damage/missing.	√	√	√
2.4	Examine body side doors for working/ damages	√	√	√
2.5	Inspect door handles for damages/missing	√	√	√
2.6	Inspect vestibule and its Rubber fittings for damages/missing, repair if necessary.	√	√	√
2.7	Visually check vestibule fall plates, mounting brackets, pins and operation of sliding doors and its lock lever for ease of operation, damages/ deficiency	√	√	√

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
2.8	Thoroughly clean and remove dust, dirt accumulated at pillars in lower & upper deck with coir brush	-	-	√
2.9	Examine for corrosion of sole bar and other under frame members with torch light or inspection hand lamp	-	-	√
2.10	Touch up damaged paint both inside & outside	-	-	√
2.11	Check double decker roof ventilator for damages/defects.	-	-	√
3.0	**BOGIE & AIR BRAKE**			
	Bogie Frame and Bolster Assembly			
3.1	Perform a visual check on longitudinal beams, cross beams & bolster for cracks, damages and for corrosion.	√	√	√
3.2	Perform a visual check on brake supports, damper supports, traction centre supports and anti-roll bar supports for cracks, damages and for corrosion.	√	√	√
3.3	Check bogie bolster sub assembly and brackets for cracks, damages and corrosion.	√	√	√
3.4	Wash the bogie frame thoroughly with water jet, making sure that water is not directed towards pneumatic / elect. Connections and axle bearings.	-	√	√
3.5	Examine the bogie/body frame for corrosion / damages, especially at critical locations like lower web, yaw damper bracket & FIBA area etc	-	-	√
3.6	Carry out paint touch up as per RCF specifications MDTS – 166.	-	-	√

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
4.0	**Brake Equipments**			
4.1	Check functionality of air brake equipment and (Hand brake equipment in LWLRRM).	√	√	√
4.2	Perform a visual check on Brake cylinders/ brake levers and Hand brake equipment in LWLRRM for damage, cracks and corrosion.	√	√	√
4.3	Perform a functional test on pneumatic brake system. Make sure that no air leaks are present.	√	√	√
4.4	Perform a visual check on all air hoses.	√	√	√
4.5	Visually inspect steel piping for cracks/ damages/ ballast hitting. Repair/ replace if necessary.	√	√	√
4.6	Perform a visual check on brake discs for cracks on face, fins, hub etc.	√	√	√
4.7	Verify that the clearance between each brake pad and disc surface is 1-1.5 mm.	-	-	√
4.8	Check wear of brake pads/ brake discs.	√	√	√
4.9	Lubricate the brake levers, fixings and all moving parts.	-	√	√
5.0	**Wheel slide Protection**			
5.1	Perform a visual check on all grounding cables & WSP equipment cables for breaks/ damages.	√	√	√

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
5.2	Visually check equipment like front axle cover & upper & lower control arms for any damages, cracks, and corrosion marks.	√	√	√
5.3	Check functioning of WSP equipments (in WSP panel & its codes).	√	√	√
5.4	Inspect the Earthing equipment for wear of slip assembly / carbon bars.	-	-	√
5.5	Check speed sensor gap	-	-	√
6.0	**Primary & Secondary Suspension**			
6.1	Visually check primary springs for cracks & damages.	√	√	√
6.2	Visually check safety wire ropes between bogie frame and bogie bolster for damages, and corrosion.	√	√	√
7.0	**Secondary Air Spring suspension with control equipments**			
7.1	Check all Air springs for any damages/leakages	√	√	√
7.2	Each air spring assembly is controlled by an independent levelling valve (4-pont control system), same to be checked for any leakage & proper functioning.	√	√	√

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
7.3	Two air springs of the same bogie are connected through a duplex check valve set to act at a pressure differential of 1.5±0.12 Kg/cm2, same to be checked for leakage etc.	√	√	√
7.4	Check 150 lts. auxiliary air reservoir for proper securing and any damage.	√	√	√
7.5	Check additional air reservoir of volume 60 dm3 permanently connected to air spring for any leakage.	√	√	√
7.6	Minimum air cushion provide under minimum tare load condition is 25 to 30 mm with installed height 294+0/-5 m m. Check air spring & adjust spring height with the help of installation lever.	-	√	√
7.7	Check green indication in FIBA (Failure Indication & Brake Application) at either end near foot step.	-	√	√
8.0	**Primary/Secondary/Yaw dampers**			
8.1	Perform a visual check on dampers for damage, cracks and oil leaks.	√	√	√
8.2	Perform a visual check on all fixings for loosening and/or missing components	√	√	√
8.3	Perform a visual check on rubber elements for cracks and ageing.	√	√	√

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
9.0	**Bearings (CTRB/TBU)**			
9.1	Carry out bearing feeling for detection of hot bearing.(During rolling –in Examination)	√	√	√
10.0	**Wheel & Axle**			
10.1	Perform a visual check on wheels for cracks	√	√	√
10.2	Check by wheel profile gauge	-	√	√
10.3	Check axle for cracks and signs of corrosion	√	√	√
10.4	Check tread diameter and wear of wheel profile. If necessary, perform re-profiling.	-	√	√
10.5	Check wheels offset on axle (1600 ±1 mm)	-	-	√
11.0	**Control Arm**			
11.1	Perform a visual check on all fixings for loosening and / or missing components	√	√	√
11.2	Visually check control arm parts for damages, cracks or corrosion marks.	√	√	√
11.3	Inspect the rubber joints for damages and ageing.	--	--	√
12.0	**Anti Roll bar Assembly**			
12.1	Perform a visual check on Anti roll bar, links and Brackets	√	√	√

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
	for cracks, damages and corrosion.			
12.2	Perform a visual check on rubber joints for cracks, damage and ageing.	-	-	√
12.3	Visually inspect for grease oozing out of anti roll bar bearings, which may result in bearing failure.	√	√	√
12.4	Perform visual check on all fixing for loosening/missing fittings.	√	√	√
13.0	**Traction Centre**			
13.1	Perform a visual check on the traction centre lever and on the rods for cracks, damages and corrosion.	√	√	√
13.2	The assembly should be free to move, and not blocked by any foreign objects.	√	√	√
13.3	Perform a visual check on all fixings for loosening.	√	√	√
13.4	Perform a visual check on rubber joints for cracks/damages.	√	√	√
13.5	Greasing of anti roll bar	-	√	√
14.0	**Rotation Limiter**			
14.1	Perform a visual check of rotation limiter, components	√	√	√

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
15.0	**Rubber and Rubber/Metal Bonded parts**			
15.1	Perform a visual check on Rubber and Rubber/Metal bonded parts for cracks, damages and ageing.	-	√	√
16.0	**Pins and bushes**			
16.1	Lubricate all pins and Bushes.	-	√	√
17.0	**Body works -**			
17.1	General inspection of Vehicle body work (paint work, glazing).	-	√	√
18.0	**Draw & Buffing Gears -** **(Ref: CMI No: RDSO/2006/CG/CMI/01 Rev No: Nil)**			
18.1	Visual Inspection of Tight lock coupler head for damage.	√	√	√
18.2	Visual Inspection of Knuckle for damage.	-	-	√
18.3	Checking of coupler operating mechanism for damage, loose, bolts etc.	√	√	√
18.4	Greasing of Slide rod of coupler operating mechanism.	-	√	√
18.5	Checking tell tale recess for ensuring proper coupling.	√	√	√
18.6	Inspection of coupler carriers/supporting device & its spring for cracks & breakage	√	√	√
18.7	Inspection of loose/broken/missing nuts & bolts (M-16) of	√	√	√

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
	coupler pin support plate & draft gear support plate.			
19.0	**Corridor Connections -**			
19.1	Check corridor connections for external damage & foreign bodies.	√	√	√
19.2	Check vestibule connection for external damage & foreign bodies.	√	√	√
20.0	**Air Pressure Equipment**			
20.1	Dry out air - filter	-	-	√
20.2	Clean air - filter	-	-	√
20.3	Clean airline - filter	-	-	√
20.4	Drain air Reservoirs & Air spring reservoir	√	√	√
21.0	**Interior fitting passenger accommodation-**		√	
21.1	General visual check for damage	√	√	√
21.2	Check for regulation provision in dust bins & operational fire extinguishers.	√	√	√
21.3	Check hand rails, sliding doors, shutters, toilet doors, vestibule doors and their functioning.	√	√	√

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
21.4	Check bath room fittings visually	√	√	√
21.5	Clean top & bottom guide rails of luggage doors of power cars & greasing of guide bearing.	√	√	-
21.6	Inspect seats & check for completeness.	-	√	√
21.7	Inspect luggage racks & check for completeness.	-	√	√
21.8	Check all hand-rails manually for correct fitment & fixing.	-	√	√
21.9	Inspect PVC floors and chequered plates for any damage.	-	√	√
21.10	Checks stick-on notices and directions for condition & completeness.	-	√	√
21.11	Check Leaf sliding door - general function & ease of movement.	√	√	√
21.12	Check leaf connection door - general function & ease of movement.	√	√	√
21.13	Check all hand-rails manually for correct fitment & fixing in lower & upper decks.	-	√	√
22.0	**Passenger Doors**			
22.1	Check General functions of passenger doors for ease of movement	√	√	√
22.2	Lubricate door seals	-	-	√

S.No		Maintenance Schedules		
	Particulars	**D1** **Trip/Weekly**	**D2** **Monthly**	**D3** **H/YLY**
	Frequency of Examination	**Every Trip /Weekly**	**30±3 days**	**Six Month±15 days**
	Maintenance to be done at:	On rake at nominated Primary Depot	On rake at nominated Primary Depot	On rake at nominated Primary Depot
22.3	Clean & lubricate door mechanisms.	-	√	√
23.0	**Water supply system -**			
23.1	Check tanks pipes for leakage.	√	√	√
23.2	Check tank mountings brackets and fittings.	√	√	√
23.3	Rinsing the pipes & water tanks	-	√	√
24.0	**Pantry**			
24.1	Check for damages & deficiencies in the pantry construction , fittings& water supply & drainage of the pantry area	√	√	√
25.0	**Sanitary Equipments**			
25.1	Check functioning of toilet system.	√	√	√

ANNEXURE 12.6

MUST CHANGE ITEMS DURING SHOP SCHEDULE –II

The following items must be replaced as must change items during the shop schedule-II:

1. All Rubber and Rubber/Metal Bonded Components, Such As-
   - Control Arm Silent Block.
   - Traction Centre Silent Block.
   - Traction Rod Silent Block.
   - Vertical Rod Silent Block.
   - Lateral/Longitudinal Bump Stops.
   - Damper End-Mountings.
   - Miner Pads for Secondary Suspension.
   - Other Rubber and Rubber/Metal Bonded Parts, If Any.
2. Bearing for Anti Roll Bar.
3. Pins, Bushes, Seals, Split Pins, Fasteners.
4. Curtains of partitions and windows.
5. PVC of Aisle area
6. Floor area (anti slip PVC or aluminum chequered plate).
7. Mirrors
8. Nylon belts of sliding door.
9. Nylon/steel wire rope of Gang Bridge.
10. Vestibule foot plate split pin
11. All Dampers to be Replaced During Shop Schedule-III.
12. Vestibule foot plate pin and nylon wire rope (for vestibule sliding doors).

ANNEXURE 12.7

TOOLS & EQUIPMENTS FOR FIAT BOGIE

The followings Tools & Equipment are required for maintenance of FIAT bogie. This list is not exhaustive and may require additional item as required.

1. Hydraulic lifters (Jacks) for lifting the coach body capacity 15 Ton - 4 Nos.
2. Tool kit (Torque wrenches, Allen keys, pliers, spanners set etc.)
3. Press for removal & pressing of bolster beam.
4. EOT crane (5 Ton) for lifting of bogie frame/Bolster.
5. Supports (Trestles) for putting bolster beam.
6. Wire rope slings and trestles for rotation of bogie frame.
7. High pressure jet cleaning machine.
8. Bogie painting facilities.
9. Hydraulic press for primary suspension.
10. Hydraulic equipment for bearing installation & removal.
11. Hydraulic press (50 Ton) for removal/insertion of rubber joints.
12. Wheel profile Lathe.
13. Wheel balancing equipment.
14. Wheel press (for pressing wheel on axle).
15. Axle dia measurement gauge/micrometer.
16. GO/NO GO threads plug gauge for axle ends.
17. Gauge for checking Bearing Mounted End Play.
18. Bench end-play checking fixture.
19. Lubrication fixture for bearing.
20. Parallelism checking tool for control arm.
21. Equipment for pneumatic System Functional Test.
22. Spring testing machine for Load/Deflection Test (vertical & horizontal both)
23. Single car testing rig for air brake system.
24. Testing machine for Primary/Secondary/Yaw dampers.
25. Mounting/ dismounting tools for Anti roll bar bearing.
26. Mounting/ dismounting tools for Anti roll bar elastic joint.
27. Miner pad pressing Fixture.

ANNEXURE - 12.8

TOOLS REQUIRED FOR DEPOT MAINTENANCE

Sr No	Tools	Supplier & Item No	Reference
1	Combination spanner set size 23; (5,5 - 34)	General purpose, readily available in market	Alstom Manual Chapter 4
2	Small open-ended spanners size 10 (4-11)	- do -	- do -
3	Double open-ended spanners size 13 (6-41)	- do -	- do -
4	Double open-ended spanner 41x46	- do -	- do -
5	Double ring-spanner set size 11; (6-34)	- do -	- do -
6	Double ring-spanner set size13; (6-41)	- do -	- do -
7	Socket set W Stahlwille Chrome - Alloy 30 piece- ¼-inch	- do -	- do -
8	Socket set - 3/8-inch	- do -	- do -
9	Socket set size 11 (5,5-17)	- do -	- do -
10	Screwdriver blades - assorted 10 piece	- do -	- do -
11	Quick-fit coupling, 1/4 inch, 74 mm D6,3	- do -	- do -
12	Connector, 3/8 inch size 20	- do -	- do -
13	Hexagon – Offset-screwdriver set, size 9; 1,5 - 10 mm	- do -	- do -
14	Tool-holder with ratchet, 85 mm	- do -	- do -
15	Tool-holder with ratchet, 100 mm	- do -	- do -
16	Adjustable spanner, 205 mm	- do -	- do -
17	Adjustable spanner, 0-42 mm	- do -	- do -
18	Long-nosed pliers, bent	- do -	- do -
19	Long-nosed pliers, straight	- do -	- do -
20	Combination pliers160 mm	- do -	- do -
21	Combination pliers 250 mm	- do -	- do -
22	Pipe-wrench, Swedish, size 2	- do -	- do -
23	Circlip pliers, internal size J0 (8-25)	- do -	- do -
24	Circlip pliers, internal size J2 (19-60)	- do -	- do -
25	Circlip pliers, internal size J3 (40-100)	- do -	- do -
26	Circlip pliers, internal size J4 (85-165)	- do -	- do -
27	Engineer’s hammer 200 g	- do -	- do -
28	Engineer’s hammer 500 g	- do -	- do -
29	Engineer’s hammer 1000 g	- do -	- do -
30	Rubber hammer size A600	- do -	- do -
31	Light metal hammer size 500	- do -	- do -
32	Screwdriver - Slot 2,5 mm	- do -	- do -
33	Screwdriver - Slot 3,0 mm	- do -	- do -
34	Screwdriver - Slot 3,5 mm	- do -	- do -
35	Screwdriver - Slot 4,0 mm	- do -	- do -
36	Screwdriver - Slot 4,5 mm	- do -	- do -
37	Screwdriver - Slot 5,5 mm	- do -	- do -
38	Screwdriver - Slot 6,5 mm	- do -	- do -
39	Screwdriver - Slot 8,0 mm	- do -	- do -
40	Screwdriver - Slot 10,0 mm	- do -	- do -
41	Screwdriver – Short 1K	- do -	- do -

Sr No	Tools	Supplier & Item No	Reference
42	Screwdriver – Short 2K	- do -	- do -
43	Screwdriver – Short 4	- do -	- do -
44	Screwdriver – Short 5,5	- do -	- do -
45	Screwdriver – Short 6,5	- do -	- do -
46	Screwdriver – cross-slot 5-piece set	- do -	- do -
47	Ellen Key set (1 mm to 25 mm)	- do -	- do -
48	Hexagon – ball-end screwdriver 10 piece	- do -	- do -
49	Screwdriver 13	- do -	- do -
50	Screw-holding screwdriver - Grip 3,5/115	- do -	- do -
51	Screw-holding screwdriver - Grip 5,0/95	- do -	- do -
52	Screw-holding screwdriver - Grip 5,5/115	- do -	- do -
53	All-purpose shears size 200	- do -	- do -
54	3 m tape-measure	- do -	- do -
55	Calliper gauge 150 mm	- do -	- do -
56	Small hack-saw with 2 blades	- do -	- do -
57	Keyhole files, set of 6	- do -	- do -
58	Screw extractor, sizes 1-6	- do -	- do -
59	Nut-splitter M4-M14	- do -	- do -
60	Nut-splitter M14-M24	- do -	- do -
61	Steel pipe-cutter size 2	- do -	- do -
62	Pipe-cutter for VA/Cu (6-64mm)	- do -	- do -
63	Steel-wire brush size 5	- do -	- do -
64	Spirit-level size 1000	- do -	- do -
65	Feeler gauge size 20	- do -	- do -
66	Adjustable pin-type face-wrench size 4	- do -	- do -
67	Torque wrench 8-40NM	- do -	- do -
68	Torque wrench 50-300NM	- do -	- do -
69	Torque wrench 250-750NM	- do -	- do -
70	4-point-jacking system 50t capacity (Suitable for LHB vehicle)	- do -	- do -
71	Jacking system for 5t (bogie)	- do -	- do -
72	Jacking system-Scissors-type jacking table 0.8t	- do -	- do -
73	Ladder model 1, 7-step, working height 1,54m	- do -	- do -
74	Multi meter (For WSP & CDTS electrical wiring)	- do -	- do -
75	Insulation tester	- do -	- do -
76	Digital temperature measuring instrument (for measuring bearing temperature)	- do -	- do -
77	BOX SPANNER No.19 for Ventilator	- do -	- do -
78	laptop PC with installed WSP software (for WSP System)	- do -	- do -
79	Lifting tool for luggage racks	- do -	- do -
Special tools			
80	Press for secondary suspension	FIAT 126.130.376	- do -
81	Parallelism check tool	FIAT 128.410.502	- do -
82	Press for MINER springs	FIAT 122.700.171	- do -
83	CBC gauges (Set of 07 gauges) Both M/s FTIL & M/s ASF make	-	OEM Manual i.e. M/s FTIL & M/s ASF

ANNEXURE 12.9

PROFORMA TO BE FILLED IN CASE OF CTRB FAILURE OF LHB COACHES

S.N	Details	Observation	S.N.	Details	Observation
1	**Occurrence Particulars**		**5**	**Bearing particulars**	
a	Date of Failure		a	Bearing side (phonic, earthing or plain side)	
b	Station		b	Bearing marks	
c	Section		c	Bearing No.	
d	Division		d	Mfg. Date of bearing	
e	Railway		e	Within warranty or beyond warranty	
2	**Train Particulars**		f	Refurbished/New	
a	Train no.		g	If refurbished date of refurbishing	
b	Last examination station		h	Check for any damage to grease seal	
c	Last examination date		**6**	**Affected end**	
d	Distance traveled since last examination		**i**	**Phonic wheel side**	
3	**Failure particulars**		a	WSP functional or not	
a	Description of failure		b	Phonic wheel present or not	
b	How failure detected		c	Sensor cable present or not	
c	Position of affected coach from loco		d	Physical condition of sensor damage/rubbing mark	
4	**Coach Particulars**		e	Gap between phonic wheel & sensor	
a	Coach Nos.		f	Phonic wheel mounting M8 screws/bolts present or not	
b	Coach Type		g	Make of (WSP, Sensor & phonic wheel)	
c	Coach Built by		h	Make of M8 bolts	
d	Coach Built year		i	Property class of M8 bolts	
e	D1 Schedule date		j	Phonic wheel M8 screws/Bolts condition	
f	D2 Schedule date		k	Spring washer of M8 bolts present or not	
g	D3 Schedule date		l	M8 Screws/bolts Full or half threaded	
h	IOH date		m	Sensor fixing bolts are present/damage or not available	
i	POH date		n	Phonic wheel OD-wear/ damage	

S.N	Details	Observation	S.N.	Details	Observation
j	Return date		o	Max temperature	
k	POH shop				
ii	**Earthing Side** (if failed earthing side		e	Condition or end locking screws	
a	Make of earthing device		f	Condition of end locking plate	
b	Earthing device functional or not		g	End locking plate tab is bent against End cap screw (all 3 screws)	
c	Earthing cable present or not		h	Heat/burn marks on the Axle end cover/control arm	
d	Physical condition of carbon bushes		**9**	**Vertical Damper**	
e	Spring of carbon bushes functional or not		a	Check the vertical damper functional or not	
7	**Control arm**		b	Leakage of lubricant	
a	Visual check on all fixings for loosening and/or missing components.		c	Check the bolts & nuts present or not	
b	Check the control arm to see is misaligned or not		**10**	**Wheel**	
c	If there is gap between the upper and lower control arm, then measure it.		a	Wheel shelling is present or not (depth-1 5 mm Max.,& depth or hollow tyre-3mm Max.)	
d	Visually check control arm parts for damages, cracks or corrosion marks.		b	Wheel flat present or not (Max. 50mm)	
e	Drain holes chocked or open		c	Wheel diameter affected side	
8	**Axle end over**		d	Wheel diameter Other End (Mate Bearing)	
a	Axle end cover mounting bolt missing/loose		e	Position/location of affected wheel in coach	
b	Inspection bolt present or not at axle end cover		f	Stamping particulars of wheel	
c	Axle end cover physical condition at the phonic wheel area any sign of rubbing		g	UST particular of wheel	
d	Axle end cover rusted or not				

ANNEXURE 12.10

PREVENTIVE CHECKS ON WSP OF KNORR BREMSE IN D2 Schedule

S.N	Item	Scope	Method of Checking	Result
1.	**Wiring**	a) Between speed sensor and junction box.	Two wires check continuity using multimeter.	1st Sensor 2nd Sensor 3rd Sensor 4th Sensor
		b) Between Junction Box and WSP Panel	i. Two wires disconnect at 1st junction box. ii. Fault code "11"will display on microprocessor. iii Cannot be reset. iv Connect back two wires. v It should be possible to reset "11" if connections have been made properly and are thus OK. vi Similarly, repeat for 2nd, 3rd, and 4th Junction Box. The corresponding fault codes are "21", "31", and "41".	1st Junction Box 2nd Junction Box 3rd Junction Box 4th Junction Box
		c) Between Dump Valve and WSP Panel	i. Three wires disconnect at 1st Dump Valve. ii. Fault code "13" will display on microprocessor. iii. Cannot be reset. iv. Connect back three wires. v. It should be possible to reset "13" if connections have been made properly and are thus OK. vi. Similarly, repeat for 2nd, 3rd, and 4th Dump valve. The corresponding fault codes are "23", "33" and "43".	1st Dump Valve 2nd Dump Valve 3rd Dump Valve 4th Dump Valve
2.	**K-05 Relay (01No)**	Timer Setting	Specified: 10+1 minutes	
3.	**Pressure Switch**	Cut in pressure Cut of pressure	0.5 Kg/cm^2 0.2 Kg/cm^2	
4.	**Speed Sensor (04Nos.)**	Check if Speed Sensors are providing the speed Signal to	i. Fit "1" Sensor (duly wired to WSP) on the mounting flange of the 'Polradsimulator".	1st Sensor 2nd Sensor

S.N	Item	Scope	Method of Checking	Result
		WSP	ii. Run "Polradsimulator" for <2 seconds. iii. 1st Dump valve should operate (checked by air exhaust which takes place when dump valve operates). iv. This checks that 1st sensor is providing the speed signal to WSP. Similarly, check 2nd, 3rd, and 4th Dump Valves respectively operating.	3rd Sensor 4th Sensor
5.	**Gap between Speed Sensor and Toothed Wheel**	To be checked by filler gauge.	Specified : 0.9 mm to 1.4 mm	Gap 1st Sensor Gap 2nd Sensor Gap 3rd Sensor Gap 4th Sensor
6.	**Dumps Valves (04Nos.)**	Check for operation of 04 Nos. Dump Valves.	i. Press "S2" switch on micro-processor. ii. Release "S2" switch when "8888" display on screen then dump valve will start operating as below: iii. 1st Dump Valve will operate. iv. 2nd Dump Valve will operate. v. 3rd Dump valve will operate. vi. 4th Dump Valve will operate. vii. "99" display will come on screen in the end. Air exhaust should take place from the Dump Valve when particular Dump Valve operates.	1st Dump Valve 2nd Dump Valve 3rd Dump Valve 4th Dump Valve
7	**Emergency Accelerator Valve (01 Nos.)**	Check for operation of Emergency Accelerator Valve by applying emergency brake thereby rapidly dropping BP up to 3 kg/cm^2 and then stop further dropping of BP	Momentary air exhaust should take place from Emergency brake is applied and then exhaust should stop automatically. Operating thus, the emergency Brake Valve is OK	Operates when BP drops at 2.5 kg/cm^2

PREVENTIVE CHECKS ON WSP OF M/s FAIVELEY TRANSPO

S.No.	Item	Scope	Method of Checking	Result
1.	**Wiring**	a) Between speed sensor and junction box.	Two wires check continuity using multimeter.	1st Sensor 2nd Sensor 3rd Sensor 4th Sensor
		b) Between Junction Box and WSP Panel	i. Two wires disconnect at 1st junction box. ii. Fault code "11"will display on microprocessor. iii Cannot be reset. iv Connect back two wires. v It should be possible to reset "11" if connections have been made properly and are thus OK. vi Similarly, repeat for 2nd, 3rd, and 4th Junction Box. The corresponding fault codes are "21", "31", and "41".	1st Junction Box 2nd Junction Box 3rd Junction Box 4th Junction Box
		c) Between Dump Valve and WSP Panel	i. Three wires disconnect at 1st Dump Valve. ii. Fault code "14" will display on microprocessor. iii. Cannot be reset. iv. Connect back three wires. v. It should be possible to reset "14" if connections have been made properly and are thus OK. vi. Similarly, repeat for 2nd, 3rd, and 4th Dump valve. The corresponding fault codes are "24", "34",and "44".	1st Dump Valve 2nd Dump Valve 3rd Dump Valve 4th Dump Valve
2.	**K-05 Relay (01No)**	Timer Setting	Specified: 2 minutes	
3.	**Pressure Switch**	Cut in pressure Cut of pressure	2.0 Kg/cm^2 1.0 Kg/cm^2	
4.	**Speed Sensor (04Nos.)**	Check if Speed Sensors are providing the speed Signal to WSP	i. Fit "1" Sensor (duly wired to WSP) on the mounting flange of the 'Polradsimulator". ii. Run "Polradsimulator" for <2 seconds. iii. 1st Dump valve should operate (checked by air exhaust which takes place when dump valve operates).	1st Sensor 2nd Sensor 3rd Sensor 4th Sensor

S.No.	Item	Scope	Method of Checking	Result
			iv. This checks that 1st sensor is providing the speed signal to WSP. v. Similarly, check 2nd, 3rd, and 4th Sensor by fitting on "Polradsimulator" one by one Dump Valves respectively operating.	
5.	**Gap between Speed Sensor and Toothed Wheel**	To be checked by filler gauge.	Specified : 0.9 mm to 1.4 mm	Gap 1st Sensor Gap 2nd Sensor Gap 3rd Sensor Gap 4th Sensor
6.	**Dumps Valves (04Nos.)**	Check for operation of 04 Nos. Dump Valves.	i. Press "TEST" switch on micro-processor. ii. Release "TEST" switch when "8888" display on screen then dump valve will start operating as below: iii. 1st Dump Valve will operate. iv. 2nd Dump Valve will operate. v. 3rd Dump valve will operate. vi. 4th Dump Valve will operate. vii. "99" display will come on screen in the end. Air exhaust should take place from the Dump Valve when particular Dump Valve operates.	1st Dump Valve 2nd Dump Valve 3rd Dump Valve 4th Dump Valve
7	**Emergency Accelerator Valve (01 Nos.)**	Check for operation of Emergency Accelerator Valve by applying emergency brake thereby rapidly dropping BP up to 3 bar and then stop further dropping of BP	Momentary air exhaust should take place from Emergency brake is applied and then exhaust should stop automatically. Operating thus, the emergency Brake Valve is OK	Operates when BP drops at 3.0 kg/cm^2

ANNEXURE 12.11

PERIODICAL INSPECTION OF AIR SPRINGS SYSTEM ON LHB COACHES

SCHEDULE OF INSPECTION	INSPECTION ON AIR SPRING SYSTEM	INSPECTION SITE
Schedule-D1	• Visual check: General conditions which includes any external damages, air leakage, infringement of any fittings, etc. • Draining of 150-liter air reservoir of air spring • Check the position of isolating cock and drain cock, these should be on and off position respectively. Draining of 60-liter reservoir. • Cleaning of leveling valve filter as per manufacturer's manual.	Pit line
Schedule –D2	• As in Schedule –D1 • Checking of installation lever with inflated air spring for normal function, tightening of installation lever nuts and protection screen nuts, tightening of bracket of all flexible hoses. • Cleaning of air filter of 150-liter reservoir.	Pit line
Schedule –D3	• As in Schedule –D2 & • Thorough checking of air spring, bulging of bellow, air leakage. • Air suspension pipe leakage check by using soap water. • Removing dust mud & oil deposit if any, on air spring and control equipment. • Thorough checking of square platform provided on y- frame of bogie for any crack and deformation. • Tightening of air spring bottom plate bolts and nuts. • Measurement of bogie clearances related to air spring.	Sick line
AOH/POH	• As in Schedule – D3 and • Through visual check of air spring after dismantling as in clause 4.1.5.2.13. • Remove all valves and carry out external cleaning, overhauling and function test should be done as given in maintenance manual supplied by respective vendors. • Checking securing arrangement of steel pipeline. • Leakage test of air springs as per clause 4.1.5.2.8. • Installation lever adjustment as per clause 4.1.5.2.10. • Lateral damper condition should be checked and replace with fresh if damaged. Air spring bellow should not be painted.	Depot/ ***Work shop***

ANNEXURE 12.12

Maintenance instructions for mounting & dismounting of CTRB (TBU) of SKF/ TIMKEN roller bearings used in LHB coaches in workshops

A) Maintenance of **TBU of M/s. TIMKEN**

Instruction for maintenance of **TIMKEN** Type CTBU are advised as under:

Sr. No	Activity	Action to be taken by, for TIMKEN Type CTRB
1	Inspection of **TIMKEN** Type CTRB in in-position.	1) Rotate the bearing assembly by using both hands to detect any abnormal condition. Visually check the outside of the bearing assembly for broken, loose, grease oozing, any missing parts or any external damage. 2) Check the bearing mounted end play. It should be in the range **0.096 mm to 0.330 mm.** 3) If the bearing end play is outside limits specified as above, or if any roughness is detected when the bearing is rotated by using both hands, the bearing assembly should be removed from the axle. 4) After the bearing assembly is removed from the pilot sleeve, a cardboard insert or a similar device should be inserted in the bore of the bearing assembly to hold the internal bearing parts in place. 5) When the bearing assemblies are removed from the axle, the bearing assemblies should be sent for refurbishing or condemnation, as the case may be.
2	Dismounting of the **TIMKEN** TBU with the hydraulic press	1) The bearing assemblies may be removed with a hydraulic press. 2) Pressure must be applied to the backing ring to remove the bearing. 3) When bearings are removed from the axle, a pilot sleeve should be fastened to the end of the axle or to the press ram to keep the bearing parts together and protect them from damage. Do not drop the bearing assembly when removing it from the pilot sleeve.
3	Check of the journal.	1) Axles should be checked on the bearing seat diameters at three locations, shoulders with outside micrometer to determine that finished axle dimensions are within the prescribed tolerance a) Journal dia should be **130.043 to 130.068 mm** Taper of dia must not exceed **0.02** mm over length of journal b) Shoulder dia should be **160.174 to 160.134 mm**

Sr. No	Activity	Action to be taken by, for TIMKEN Type CTRB
		2) Axle bearing seat diameters, shoulder and redii should have smooth machined and rolled, or ground finish, and must be free from sharp corners, burrs, nicks, tool marks, scratches, or corrosion. 3) Axle journals should be protected if there is possibility of damage or deformations resulting from miss handling, or uneven pressures being applied to the axle ends. 4) Any axle found with high spots should be carefully reground for the full circumference and length of the bearing seats. The refinished axle must be within the prescribed tolerance limits. 5) The journal must not have waves on its surface. This aspect can be checked by means of a metal ruler smeared with marking blue and moving it forwards and backwards on the journal in the axial direction several times. This inspection should be carried out at 90^0. If the surface plate leaves an unbroken line, the journal is good and suitable for use. If the line left on the journal is a broken line and the length, of its part is less or equal to 2/3 of the total length, the journal must be scrapped or repaired. If several short undulations are detected on the journal, the bearing seating must be reground over its entire length. The reground journal must be within the specified tolerance limits. The following rule shall be followed: **A + B + C >2/3 L** 6) All steel chips, dirt, and grease must be cleaned out of the lathe centers and end locking bolt holes should be cleaned with compressed air before applying the bearings.
4	Pressing **TIMKEN** Type CTRB Bearing Assemblies on Axle.	1) Place the wheel and axle assembly in a bearing press, in position to press the bearing assembly on to the axle. 2) Measure and record the Inner Dia of CTRB at three locations. It should be **130.0 -0.008 to -0.033 mm**. Fit the pilot sleeve onto the end of the axle, using the screws to hold it in position. Slide the bearing assembly over the pilot as far as it will go and place the assembly sleeve behind the bearing assembly. 3) Coat the bearing seats of the axle with Oil (SAE 30) to PL No. 80010271. 4) Apply pressure to the end of the assembly sleeve until the bearing assembly is correctly seated. 5) To ensure that the bearing is firmly seated against the axle filler, the pressure indicated on the gauge during pressing on should be increased by 50%. This 50% increase should be applied after the surge of pressure indicated on the gauge that the bearing assembly has contacted the axle fillet. This seating load pressure should be within the limits shown in table below:- **Seating Load = 20-25 tones. This is ~ to 150to 190 kg/cm^2**

Sr. No	**Activity**	Action to be taken by, for **TIMKEN** Type CTRB
		6) Continuously rotate the bearing assembly during pressing of CTRB till reaches its seating, to ensure that it will turn at initial application. In case these free rotations by hand struck this CTRB mounting, should be stopped and the CTRB should be removed from axle & send for refurbishing. 7) Pre caution should be taken when applying the seating load, otherwise damage may be caused to the backing ring, seal sleeve or backing spacer. On no account should the momentary seating load applying be any more than the minimum pressure specified in the table above. 8) To minimize the risk of ingress of water through the backing ring contact area with the axle, apply a sealant to the backing ring/axle interface (silicon gel). 9) After the press rams have been retracted, roll the wheel and axle assembly out of the press. Remove the assembly sleeves and bearing pilot sleeves. 10) To fit the second bearing to the opposite end of the bearing of the wheel set, care must be taken to ensure that the first bearing fitted is not subjected to further transmitted pressure.
5	Mounting of End cap	1) Apply the axle end cap. 2) Apply the locking plate and hexagon head bolts. 3) A ratchet wrench or an impact wrench may be used to “run up” the bolts. 4) Tighten the bolts with a torque wrench. Recheck each bolt does not turn when the 21.5 kgm torque is applied. 5) Lock faces of the bolts by bending all tabs of the locking plate flat against the sides of the end locking bolt heads using adjustable rib-joint plier. 6) Do not tighten or loosen a bolt after the **21.5 kgm** torque has been obtained to position the bolt head flats relative to the locking plate tabs.
6	Check of axial internal clearance (lateral)	1) Check the bearing mounting end play with the dial indicator mounted on a magnetic base. Place the magnetic base on the axle end and position the indicator stem against the face of the cap. 2) With dial indicator in position, pull hard but steadily on the bearing cup and oscillate at the same time. Without releasing the

		pressure, steady the cap so that the indicator stem contacts the marked, and note the reading on indicator dial. 3) Then push the bearing cup hard and oscillate as before, turn the cup until the stem of the indicator contact the marked spot, and without releasing the pressure take second reading. The difference between the two readings is the amount of mounted end play in the bearing. 4) If bearing end play as indicated by the dial indicator is less than minimum "MEP at installation", remove the bearing assembly from the axle. Minimum and maximum end play values are:- Mounted end play at installation = **0.096-0.330** mm,
7	Record keeping and generate individual bearing report.	
8	Record of removal, refurbishing & condemnation forwarded to SSE/LHB, SSE/EST for further co-ordination.	

B) Maintenance of TBU of M/s. SKF

Sr. No.	Activity	Action to be taken by, for SKF Type CTRB
1	Inspection of CTRB in in- position.	1) Rotate the bearing assy. by using both hands to detect any abnormal condition and visually check the outside of the bearing assembly for broken, loose, grease oozing or any missing parts or any external damage. 2) Check the bearing axial clearance **0.10 -0.40 mm**. 3) When the bearing assemblies are removed from the axle, the assemblies should be sent for refurbishing or condemnation, as the case may be.
2	Dismounting of the SKF TBU with the hydraulic press	1) Unlock the locking plate. Dismount the screws and retire the end-cap. 2) Put the Pulling Shoe over the back side of the backing ring of the TBU, put the press at the good level in order to lock the pulling flange just behind the backing ring. The pulling shoe must engage the backing ring only. 3) Build the pressure. The pressure the piston applies to the end of the journal permits to withdraw the TBU. You must sustain the TBU to avoid it falling on the piston.
3	Check of the journal.	1) Clean the TBU bearing seating, the general collar for the backing ring seat and blow the threaded holes for end cap bolts with compressed air. Journal shoulder must be free from pre-existing painting and, or antirust coating. 2) If some edges protruding outside from the journal cylindrical shape are detached on the bearing sealing, they must be carefully removed. A honing stone or emery cloth of grain size 180 to 200 is recommended. 3) The journal must not have waves on its surface. This aspect can be checked by means of a metal ruler smeared with marking blue and moving it forwards and backwards on the journal in the axial direction several times. This inspection should be carried out at 90^0 (see fig. 1 of Para 4.2 of SKF maintenance manual.) If the surface plate leaves an unbroken line, the journal is good and suitable for use. If the line left on the journal is a broken line (see fig.2) and the length, of its part is less or equal to 2/3 of the total length, the journal must be scrapped or repaired. If several short undulations are detected on the journal, the bearing seating must be reground over its entire length. The reground journal must be within the specified tolerance limits. The following rule shall be followed: $A + B + C > 2/3\ L$ Check of the bearing seating. The diameters dia **130.043 to 130.068 mm** and dia **160.174 to 160.134 mm** must be measured in 2 planes at 90^0 (maximum different value between 2 points =0.012 mm) in 3 points.

4	Pressing SKF Type CTRB Bearing Assemblies on Axle.	1) Place the rear cover, labyrinth ring and/or backing ring if it is needed before TBU mount. 2) Measure and record the inner Dia of CTRB. It should be **130.0 -0.000 to -0.025 mm**. Mount the pilot sleeve onto the journal with the bolts, in order to sustain and guide the TBU during the mounting, and tightening the screws with the tightening torque **21.5 kgm**. Check the concentricity of the pilot sleeve with the journal with a rule. 3) Mount the installer bolt onto pilot sleeve. Apply a thin and uniform coat of the most suitable agent Thick mineral oil(SAE 30) or Oil and molybdenum disulphide mixture (70% - 30%) or Anti Stick-Slip oil to the bearing and backing ring seatings on the journal, Usually Oil (SAE 30) to PL No. 80010271 4) Pick up the TBU from the pallet box, without removing the triangular retainer placed in the TBU bore, in order to avoid any movements of the central spacer. During placing the TBU on the pilot sleeve the retainer will automatically pushed out. Screw the threaded bar on the pilot sleeve. 5) Place first the mounting sleeve and second the pushing tube over the hydraulic press over the threaded bar. 6) Lock the hydraulic press against the pushing tube using the handled nut. The TBU Is now ready to be mounted. 7) Put in "ON" operation the hydraulic press and begin to get the seating force. 8) In this condition TBU starts to move onto the journal. 9) During the cold mounting of the TBU it is important to rotate by hand the outer ring of the bearing (see Fig.17). The rotation shall be free during all the mounting phase: if it jams, discontinue the operation. 10) Keep under control the dial indicator of the manometer (see Fig.18) in order to get the right seating force. 11) During the mounting the pressure **(28 to 32 tons) ~210 to 240 kg/cm^2** will gently increase. During the final seating phase, when the backing ring enters on contact with journal abutment a very quick pressure increase will be noted. This phase is called "final seating force" phase. 12) The press is equipped with a special valve limiting the pressure to a correct value **240kg /cm^2** which must be set before operating.

		13) Once the bearing is mounted, the press be "OUT" button until the mounting sleeve comes free. Unscrew the handled nut, roll the hydraulic press away, remove the threaded bar, the installer bar, the installer bolt and dismount the pilot sleeve.
	Mounting of End cap	1) Once the bearing is mounted and pilot sleeve dismounted, place the end-cap in position, put the locking plate in front of the end-cap and tightened the screws with the tightening torque **21.5 kgm**. 2) It is necessary not to bend up the locking plate tabs against the screw head corners, just use the tab which guarantees more surface against screw head.
6	Check of axial internal clearance (lateral)	1) The axle internal clearance must be measured only when the bearing is completely mounted, with the end cap fitted with the good tightening torque. 2) Check the axial internal clearance of the TBU with a magnetic base dial indicator (see Fig. 20 & 21). Move the cup by hand over the total distance from one end position to the other. It is forbidden for this operation to use a metallic lever. The value of the theoretical residual axial clearance of the TBU is indicated on the drawing as **0.10 - 0.40 mm**. It is possible that, during the measurement, a value lower than the one indicated on the drawing is found, due to the grease thickness and the applied method itself. It is than possible to accept up to a minimum value of 0.02 mm. And anyway a free rotation of the TBU outer ring must be guaranteed.
	Record keeping and generate individual bearing report.	
	Record of removal, refurbishing & condemnation forwarded to SSE/LHB,SSE/ESTIMATE for further co-ordination.	

Following activity should be performed in addition to the above activities:

Sr. No.	**Activity**	Action to be taken by, for both **TIMKEN** and **SKF** Type CTRB
1	Dismounting of control arms	Thoroughly clean the bores of housings (control arm), remove all rust or corrosion and apply a heavy coating of grease to the bores. (After immediately dismounting of control arm.)

ANNEXURE 12.13

RUBBER AND WEAR PARTS

INTRODUCTION

This chapter deals with all those components which are subjected to wear, such as rubber and metal parts used as elastic connections, pads or bump stops.

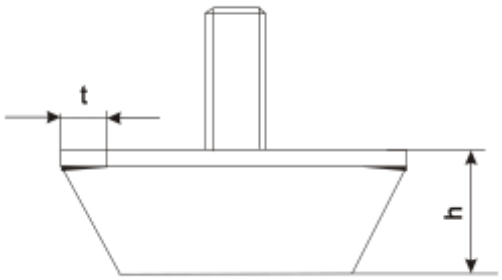
These components must be checked more often than usual structural parts, and with more care. The elastic properties of rubber change during lifetime, due to molecular alterations of the material. This phenomenon is called 'ageing'.

The following paragraphs are collected several drawings which containing the dimensions and the check curves for several rubber and wear components.

Primary suspension internal pad

WHAT TO CHECK	MEANS	INTERVAL	NOMINAL	MEASURED	LIMIT	ACTION TO PERFORM
External conditions, cracks, detachments	Visual Callipers (without sharp edges)	**SS-I**			t=8 mm	if t ≥ 8 mm, replace
Permanent deformation	Gauge Callipers	**SS-I**	h=25 mm		h=22 mm	if h ≤ 22 mm replace

t = depth of crack
h = height

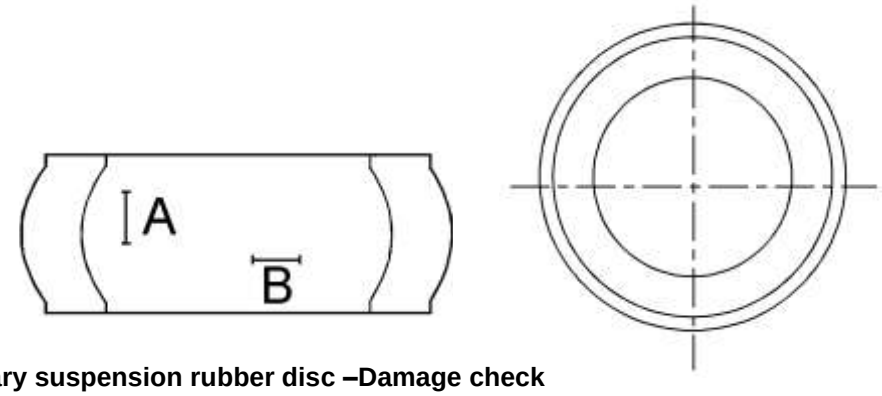


Primary suspension internal pad –Damage check

Secondary suspension rubber disc

WHAT TO CHECK	MEANS	INTERVAL	NOMINAL	MEASURED	LIMIT	ACTION TO PERFORM
Vertical cracks	Gauge and Depth Callipers	**SS-I**			length=10 mm depth=5 mm	Replace if limits are exceeded
Horizontal cracks	Gauge and Depth Callipers	**SS-I**	h=25 mm		length=40 mm depth=5 mm	Replace if limits are exceeded

A- Vertical
B- Horizontal

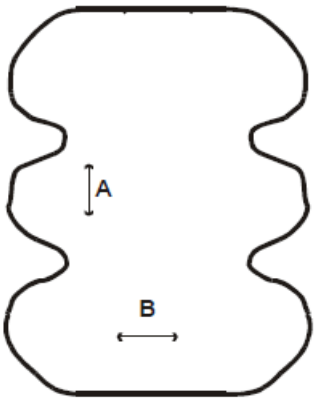


Secondary suspension rubber disc –Damage check

Secondary suspension rubber spring

WHAT TO CHECK	MEANS	INTERVAL	NOMINAL	MEASURED	LIMIT	ACTION TO PERFORM
Vertical cracks	Gauge and Depth Callipers	**SS-I**			length=<10 mm depth=< 4mm	Replace if limits are exceeded
Horizontal cracks	Gauge and Depth Callipers	**SS-I**			length=<30 mm depth=<4 mm	Replace if limits are exceeded

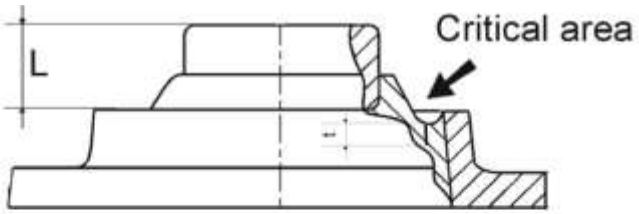
A- Vertical cracks
B- Horizonta cracks



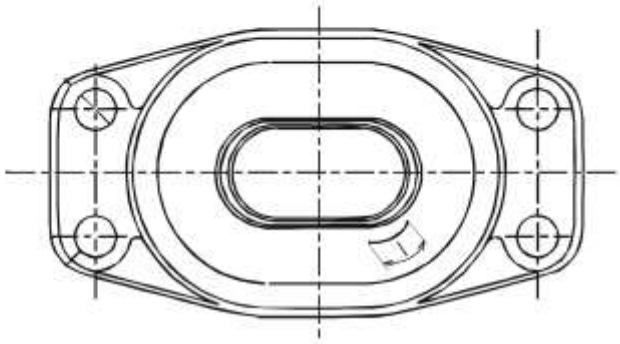
Secondary suspension rubber disc-Damage

Lateral bump stop

WHAT TO CHECK	MEANS	INTERVAL	NOMINAL	MEASURED	LIMIT	ACTION TO PERFORM
Cracks – especially check critical area	Gauge and Depth Callipers	**SS-I**			l = 60 mm t = 7 mm	Replace if limits are exceeded
Height L	Normal Callipers	**SS-I**			L = 30 mm	Replace if L < 30 mm

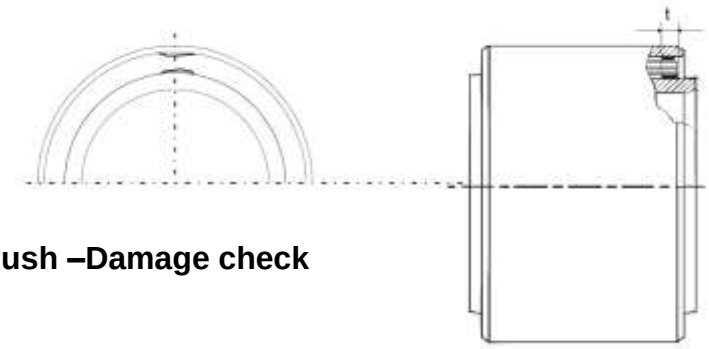


Lateral bump stop – Damage check



Traction center rubber bush

WHAT TO CHECK	MEANS	INTERVAL	NOMINAL	MEASURED	LIMIT	ACTION TO PERFORM
External conditions, cracks, detachments	Visual Callipers (without sharp edges)	**SS-I**			t = > 6 mm	if t ≥ 6 mm, replace



Traction center rubber bush –Damage check

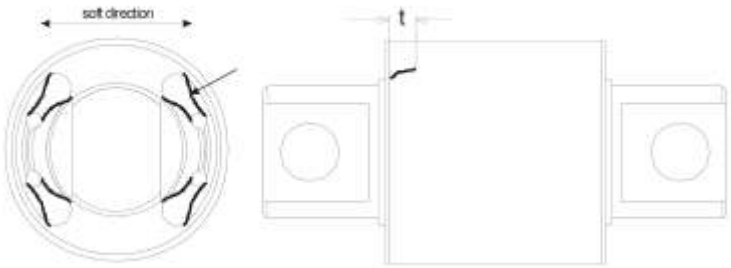
Longitudinal pad

WHAT TO CHECK	MEANS	INTERVAL	NOMINAL	MEASURED	LIMIT	ACTION TO PERFORM
External conditions, cracks, detachments	Visual Callipers (without sharp edges)				l = 23.5 mm	if l ≤ 23.5 mm replace

Longitudinal pad –Damage check

Ball joint traction levers

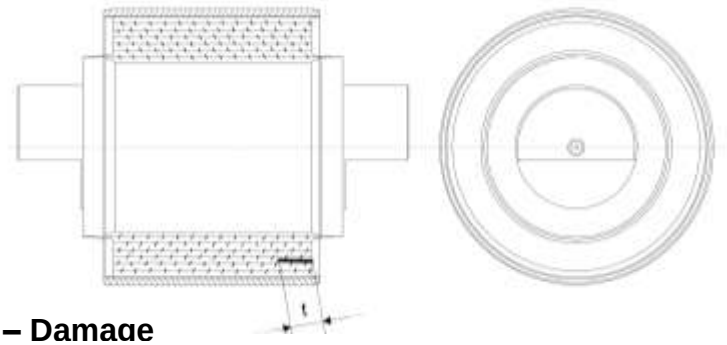
WHAT TO CHECK	MEANS	INTERVAL	NOMINAL	MEASURED	LIMIT	ACTION TO PERFORM
External conditions, cracks, detachments	Visual Callipers (without sharp edges)				t = 8 mm	if t ≥ 8 mm, replace



Ball joint traction levers –Damage check

Ball joint control arm

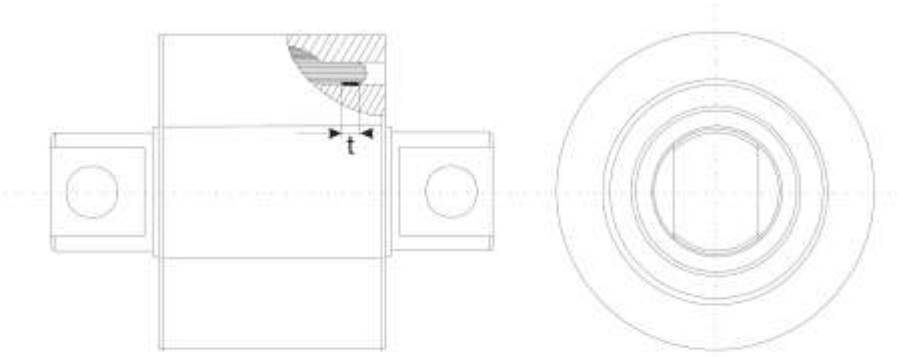
WHAT TO CHECK	MEANS	INTERVAL	NOMINAL	MEASURED	LIMIT	ACTION TO PERFORM
External conditions, cracks, detachments	Visual Callipers (without sharp edges)				t = 10 mm	if t ≥ 10 mm, replace



Ball joint control arm – Damage

Ball joint roll link

WHAT TO CHECK	MEANS	INTERVAL	NOMINAL	MEASURED	LIMIT	ACTION TO PERFORM
External conditions, cracks, detachments	Visual Callipers (without sharp edges)				t = 10 mm	if t ≥ 10 mm, replace

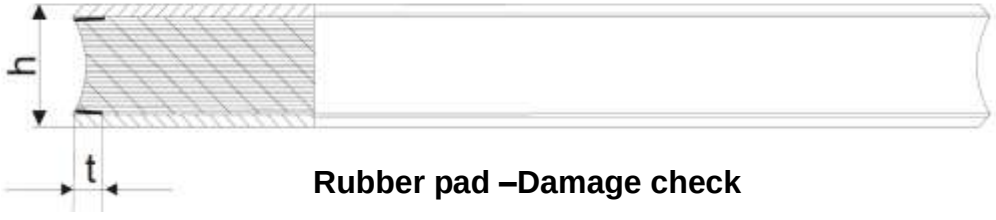


Ball joint roll link – Damage check

Rubber pad

WHAT TO CHECK	MEANS	INTERVAL	NOMINAL	MEASURED	LIMIT	ACTION TO PERFORM
External conditions, cracks, detachments	Visual Callipers (without sharp edges)				t = 10 mm	if t ≥ 10 mm, replace
Permanent deformation	Gauge Callipers		h = 36.7 mm		h = 30.7 mm	if h ≤ 30.7 mm replace

t = depth of crack
h = height



Rubber pad –Damage check

ANNEXURE 12.14

CHECK SHEET FOR BOGIE

Coach No. : **Code :**
Tare Weight : **Year Built :**
North End Bogie No.: **South End Bogie No.:**
Date of Lifting. : **Date of Lowering. :**

CONTROL ARM

A. Control arm Bracket (Bogie) half round max radius (depth)

S.NO.	INNER	OUTER	PHYSICAL CONDITION ON BOGIE
1			No dent mark/Dent mark both side/Dent mark inside/Dent mark outside/Heavy Dent mark
2			No dent mark/Dent mark both side/Dent mark inside/Dent mark outside/Heavy Dent mark
3			No dent mark/Dent mark both side/Dent mark inside/Dent mark outside/Heavy Dent mark
4			No dent mark/Dent mark both side/Dent mark inside/Dent mark outside/Heavy Dent mark
5			No dent mark/Dent mark both side/Dent mark inside/Dent mark outside/Heavy Dent mark
6			No dent mark/Dent mark both side/Dent mark inside/Dent mark outside/Heavy Dent mark
7			No dent mark/Dent mark both side/Dent mark inside/Dent mark outside/Heavy Dent mark
8			No dent mark/Dent mark both side/Dent mark inside/Dent mark outside/Heavy Dent mark

B. Control arm rubber joint half round pin maximum thickness
Manufacturer of rubber :

S.NO.	INNER	OUTER	PHYSICAL CONDITION OF RUBBER ON CONTROL ARM
1			Found OK/surface crack, rubber perished, rubber torn Dent mark both side/Dent mark inside/Dent mark outside
2			Found OK/surface crack, rubber perished, rubber torn Dent mark both side/Dent mark inside/Dent mark outside
3			Found OK/surface crack, rubber perished, rubber torn Dent mark both side/Dent mark inside/Dent mark outside
4			Found OK/surface crack, rubber perished, rubber torn Dent mark both side/Dent mark inside/Dent mark outside
5			Found OK/surface crack, rubber perished, rubber torn Dent mark both side/Dent mark inside/Dent mark outside
6			Found OK/surface crack, rubber perished, rubber torn Dent mark both side/Dent mark inside/Dent mark outside
7			Found OK/surface crack, rubber perished, rubber torn Dent mark both side/Dent mark inside/Dent mark outside
8			Found OK/surface crack, rubber perished, rubber torn Dent mark both side/Dent mark inside/Dent mark outside

SPECIFIED VALUE FOR CONDEMNATION

Item	Condemnation size
Control Arm Silent Block	**t >=10mm**

Coach No. : **Code :**

TRACTION LEVER (Centre Pivot Pin Hole Diameter)

Traction lever centre bush hole diameter.
Manufacturer. :

	AXIS	TOP	BOTTOM	Condition
NORTH END	**LATERAL**			
	LONGITUDINAL			
SOUTH END	**LATERAL**			
	LONGITUDINAL			

SPECIFIED VALUE FOR CONDEMNATION

Item	Condemnation size
Traction Lever Silent Block	t >=6mm

MANUFACTURING DETAILS OF SILENT BLOC OF TRACTION ROD

S.No.	Description	Traction rod nos.			
		1	2	3	4
1	Make				
2	Manufacturing Date				
3	Condition of Rubber	No surface Crack/ Rubber Perished/ Rubber Crack	No surface Crack/ Rubber Perished/ Rubber Crack	No surface Crack/ Rubber Perished/ Rubber Crack	No surface Crack/ Rubber Perished/ Rubber Crack

SPECIFIED VALUE FOR CONDEMNATION

Item	Condemnation size
Traction Rod Silent Block	t >=8mm

CORNER ROLLER

Corner Roller rubber condition

Roller nos.	Condition
1	
2	
3	
4	

Coach No. : **Code :**

LATERAL BUMP STOP

S. No.	Description	North End		South End	
		North East	North West	South East	South West
1	Height				
2	Condition of Rubber	Crack/ Perished/ Found OK	Crack/ Perished/ Found OK	Crack/ Perished/ Found OK	Crack/ Perished/ Found OK
3	Rubber Manufacturer				
4	Manufacturing Date				

SPECIFIED VALUE FOR CONDEMNATION

Item	Condemnation size
Lateral Bump Stop	***1. Length < 60mm*** 2. Depth > 7mm 3. Height < 30mm

CONTROL ARM HOUSING DIAMETER

S.No.	OUTER COLLAR	MIDDLE 1	MIDDLE 2	INNER COLLAR	CONDITION
1					
2					
3					
4					
5					
6					
7					
8					

SPECIFIED VALUE FOR CONDEMNATION

Control Arm Housing	Gauges	Size
MIDDLE 1 MIDDLE 2	GO	**230.065 ± 0.005**
	NO GO	**230.118 ± 0.005**
OUTER COLLAR INNER COLLAR	GO	**210.024 ± 0.005**
	NO GO	**210.178 ± 0.005**

LENGTH OF CARBON ROD

S. No.	Location of Earthing Equipment	Length in mm
1.	01 Axle box	
2.	05 Axle box	

Coach No. : **Code :**

TRACTION CENTRE PIN DIAMETER

S. No.	Location	Axis	Top	Bottom	Condition
1	**North End**	Lateral			Scratch mark/Dented/found OK
2		**Longitudinal**			Scratch mark/Dented/found OK
3	**South End**	**Lateral**			Scratch mark/Dented/found OK
4		**Longitudinal**			Scratch mark/Dented/found OK

SPECIFIED VALUE FOR CONDEMNATION

Item	Condemnation size
Traction Centre Pin	100 mm

RUBBER SPRING FREE HEIGHT AT SEC. SUSPENSION

S. No.	Free Height	Make	Condition
1			Crack/Perished/Worn out/Found OK
2			Crack/Perished/Worn out/Found OK
3			Crack/Perished/Worn out/Found OK
4			Crack/Perished/Worn out/Found OK

SPECIFIED VALUE FOR CONDEMNATION

Item	Location	Condemnation size
Secondary Suspension Rubber Spring	Vertical Crack	**1. Length >10mm**
		2. Depth >4mm
	Horizontal Crack	**1. Length >30mm**
		2. Depth >4mm

RUBBER PAD/SPACER DISC FREE HEIGHT AT SEC. SUSPENSION

S.No.	Rubber disc	Make	Condition
1			Crack/Perished/Worn out/Found OK
2			Crack/Perished/Worn out/Found OK
3			Crack/Perished/Worn out/Found OK
4			Crack/Perished/Worn out/Found OK
5			Crack/Perished/Worn out/Found OK
6			Crack/Perished/Worn out/Found OK
7			Crack/Perished/Worn out/Found OK
8			Crack/Perished/Worn out/Found OK

Coach No. : **Code :**

SPECIFIED VALUE FOR CONDEMNATION

Item	Location	Condemnation size
Secondary Suspension Rubber Pad	Vertical Crack	**1. Length >10mm**
		2. Depth >5mm
	Horizontal Crack	**1. Length >40mm**
		2. Depth >5mm
	Rejection size	**90mm to 95mm**

VERTICAL ROD

Location	Vertical Rod nos.	Description	Location of Vertical Rod			
			1	2	3	4
North End	1	Silent bloc make				
		Rubber condition				
		Indentation				
	4	Silent bloc make				
		Rubber condition				
		Indentation				
South End	2	Silent bloc make				
		Rubber condition				
		Indentation				
	3	Silent bloc make				
		Rubber condition				
		Indentation				

SPECIFIED VALUE FOR CONDEMNATION

Item	Condemnation size
Vertical Rod Silent Block	t >=10mm

Coach No. : **Code :**

CENTERING DISC AT PRIMARY SUSPENSION (PRIMARY SUSPENSION BUMP STOP PAD)

S. No.	Primary Suspension Pad	Height in mm
1	OK/body damage/rubber worn out/Rubber crack	
2	OK/body damage/rubber worn out/Rubber crack	
3	OK/body damage/rubber worn out/Rubber crack	
4	OK/body damage/rubber worn out/Rubber crack	
5	OK/body damage/rubber worn out/Rubber crack	
6	OK/body damage/rubber worn out/Rubber crack	
7	OK/body damage/rubber worn out/Rubber crack	
8	OK/body damage/rubber worn out/Rubber crack	

S. No.	Primary Suspension Bump Stop	Height in mm
1	OK/body damage/rubber worn out/Rubber crack	
2	OK/body damage/rubber worn out/Rubber crack	
3	OK/body damage/rubber worn out/Rubber crack	
4	OK/body damage/rubber worn out/Rubber crack	
5	OK/body damage/rubber worn out/Rubber crack	
6	OK/body damage/rubber worn out/Rubber crack	
7	OK/body damage/rubber worn out/Rubber crack	
8	OK/body damage/rubber worn out/Rubber crack	

SPECIFIED VALUE FOR CONDEMNATION

Item	Location	Condemnation size
Primary Suspension Bump Stop	Depth of Crack	**t >=8mm**
	Height	**h >=22mm**
Primary Suspension Pad	Horizontal Crack	**t >=10mm**
	Height	**h >=30.7mm**

CENTERING DISC AT SECONDARY SUSPENSION

S. No.	Lower Disc Condition	Upper Disc Conditon
1	Found OK/body damage/Crack	Found OK/body damage/Crack
2	Found OK/body damage/Crack	Found OK/body damage/Crack
3	Found OK/body damage/Crack	Found OK/body damage/Crack
4	Found OK/body damage/Crack	Found OK/body damage/Crack

Coach No. : **Code :**

BUMP STOP AT BOLSTER

S. No.	Shims	Conditions
1	5mm X 10mm X	
2	5mm X 10mm X	
3	5mm X 10mm X	
4	5mm X 10mm X	

SPECIFIED VALUE FOR CONDEMNATION

Item	Condemnation size
Longitudinal Bump Stop Pad	Length L <=23.5mm

APPENDIX'A'

COACH ALTERATION INSTRUCTIONS

S.No.	Descriptions	CAI No.
1	Interchangeability and breakage of window glasses of RCF Stainless Steel coaches (Rajdhani Rake-AC Sleeper Coaches)	CAI/RCF/MECH/R-SS/001
2.	Provision of Additional Drain Hole in FRP lavatory module for effective drainage in RCF Stainless steel coaches	CAI/RCF/MECH/R-SS/002
3.	Provision of Additional Drain Hole in FRP Shower room for effective drainage in RCF Stainless steel coaches	CAI/RCF/MECH/R-SS/003
4.	Cover for drain cock of under slung Water tanks (685 lts and 450 ltrs) for RCF Stainless steel coaches	CAI/RCF/MECH/R-SS/004
5.	OEM water level indicators for under slung water tanks in RCF stainless steel coaches	CAI/RCF/MECH/R-SS/005
6.	OEM Vent and vacuum valve in overhead 30 litres water tank to avoid air locking in water circulation system in RCF Stainless steel coaches (Rajdhani rake).	CAI/RCF/MECH/R-SS/006
7.	Thicker under Slung water tanks in RCF Stainless steel coaches (Rajdhani Rake-AC sleeper coaches)	CAI/RCF/MECH/R-SS/007
8.	Provision of Gravity Taps and release of space above wash basin in FRP Lavatory modules of RCF Stainless steel coaches	CAI/RCF/MECH/R-SS/008
9.	Replacement of main entrance door window glass unit	CAI/RCF/MECH/R-SS/009
10.	Working out of roller guide channel of Lavatory	CAI/RCF/MECH/R-SS/010
11.	Provision of wire rope and pulley arrangement in – place of Serrated(Toothed) belt in vestibule doors of end wall in RCF Stainless steel coaches	CAI/RCF/MECH/R-SS/011
12.	Grill instead of perforated sheet in return air duct of AC-3T coach.(Rajdhani Rake)	CAI/RCF/MECH/R-SS/012
13.	Washable synthetic Carpet-3M Nomad Carpet Matting 6500 or equivalent in FAC RCF Stainless steel coaches	CAI/RCF/MECH/R-SS/013
14.	Increase of recess in Bottle Holder of polycarbonate Snack table provided in RCF Stainless steel coaches	CAI/RCF/MECH/R-SS/014
15.	Protection wall for SLR coaches to prevent blockage of sliding door path in luggage room by falling luggage in RCF stainless steel coaches (Rajdhani/Shatabadi coaches)	CAI/RCF/MECH/R-SS/016

S.No.	Descriptions	CAI No.
16.	Sturdy ladder in RCF Stainless steel FAC coaches	CAI/RCF/MECH/R-SS/017
17..	Provision of door stopper for main entrance door to arrest out side excess swing of door in RCF stainless steel coaches (Rajdhani Rake)	CAI/RCF/MECH/R-SS/019
18.	OEM Industrial Lock in RCF Stainless steel coaches (Rajdhani Rake)	CAI/RCF/MECH/R-SS/020
19.	Back pieces for mounting lavatory door pivot to ensure working out of lavatory doors for RCF Stainless steel coaches (Rajdhani Rake)	CAI/RCF/MECH/R-SS/022
20.	Elimination of alarm pull points from lavatories of LHB design coaches.	CAI/RCF/MECH/R-SS/023
21.	Provision of isolating cock on the branch pipe connecting the brake pipe to the passenger emergency alarm valve and alarm pull boxes	CAI/RCF/MECH/R-SS/024
22.	Specification for annual maintenance contract for the following systems • MDTS160 rev-1 for AMC of axle mounted disc brake system • MDTS161 rev-1 AMC for CDTS • MDTS163 rev-0 AMC for interior doors • MDTS164 rev-0 AMC for main entrance door • MDTS165 rev-0 AMC for Power car loading door	CAI/RCF/MECH/R-SS/025
23.	Specification prepared by RCF for bought out components	CAI/RCF/MECH/R-SS/026
24.	Pocket size Trouble shooting guide for CDTS to help on board staff. • For M/s AIKON Technologies • For M/s VIBHU composite works	CAI/RCF/MECH/R-SS/027
25.	Alternate design for sealed window glass unit as polycarbonate	CAI/RCF/MECH/R-SS/028
26.	Improved design for main entrance door for future procurements only-incorporating • Window design similar to coach window • Conventional type of locking arrangement.	CAI/RCF/MECH/R-SS/029
27..	RCF drawing incorporating users suggestions for future procurements • Bi-folding lavatory doors • Vestibule double leaf door	CAI/RCF/MECH/R-SS/030

APPENDIX'B'

TECHNICAL SPECIFICATION OF LHB COACHES

S.No.	Descriptions	T.S.No
1	Helical suspension Springs	T.S.No. 17.248.100 ver. 05
2.	Paint structure	T.S.No. 17.318.136.ver.02
3.	Material, Inspection and Acceptance Criteria for Spheroidal Graphite Cast Iron.	T.S.No. 17.334.100.ver.06
4.	Material, Inspection and Acceptance Criteria for Spheroidal Graphite Cast Iron	T.S.No. 17.334.107.ver.01
5.	Material, Inspection and Acceptance Criteria for Spheroidal Graphite Cast Iron	T.S.No. 17.334.110.ver.01
6.	Material, Inspection and Acceptance Criteria for Spheroidal Graphite Cast Iron	T.S.No. 17.358.100.ver.08
7.	Instruction Sheet for Steel Casting	T.S.No. 17.358.105.ver.01
8.	Instruction Sheet for Steel Casting	T.S.No. 17.358.114.ver.01
9.	Rubber Metal Component (axle guide bush ALL)	T.S.No. 17.359.100.ver.03
10.	Coupling and Installation Instruction for Flexicoil Secondary Spring.	T.S.No. 17.471.101.ver.01
11.	Lifting Rope	T.S.No. 17.526.100.ver.02
12.	Brake Cylinder with Mechanical Locking Brake	T.S.No. 17.505.100.ver.02
13.	Brake Disc	T.S.No. 17.503.100.ver.02
14.	Brake Cylinder	T.S.No. 17.501.100.ver.02
15.	Brake Caliper for Disc Brake	T.S.No. 17.499.100.ver.02
16.	Pads for Secondary Suspension	T.S.No. 17.477.100.ver.02
17..	General Rubber –Metal Elements	T.S.No. 17.531.100.ver.03
18.	Rubber Metal Component (Traction rod bush)	T.S.No. 17.532.100.ver.00
19.	Rubber Metal Component (Centre pivot bush)	T.S.No. 17.533.100.ver.00
20.	Earthing Contact	T.S.No. 17.557.100.ver.01
21.	Carrying wheel set	T.S.No. 17.558.100.ver.01
22.	18 t Carrying Wheel Set	T.S.No. 17.558.102.ver.00
23.	Hydraulic Dampers	T.S.No. 17.560.100.ver.03
24.	Wheel Set Bearing	T.S.No. 17.565.100.ver.01
25.	Operative Range of Products used by Fiat-SIG	T.S.No. 17.617.100.ver.02
26.	Anti- Roll Bar	T.S.No. 17.619.100.ver.00
27..	Amendment No. 1 of march 2005,Material, Inspection and Acceptance Criteria for Spheroidal Graphite Cast Iron	T.S.No. 17.334.110.ver.01
28.	Amendment No. 1 of October 2004, Helical suspension Springs	T.S.No. 17.248.100 ver. 05
29.	Amendment No. 1 of march 2005, Instruction Sheet for Steel Casting	T.S.No. 17.358.105.ver.01
30.	Amendment No. 2 of January 2005, Coupling and Installation Instruction for Flexicoil Secondary Spring	T.S.No. 17.471.101.ver.01

APPENDIX 'C'

INFRASTRUCTURE FACILITIES AND M&P REQUIRED FOR MAINTENANCE OF LHB DESIGN COACHES IN COACHING DEPOTS AND WORKSHOP

Coaching Depot: Following facilities in terms of M&P, tools and equipments should be available in the coaching depot:

(i) Unified pit line: The unified pit line should be as per RDSO's drawing number RDSO/M-00006/R or CAMTECH's report no. CAMTECH.M.Infra.99/1.0 depending upon whether loco movement is required or not on the pit line.

(ii) Vacuum pipe line of 6" diameter with tapping arrangement at every coach with quick couplings, vacuum exhauster and connectivity with the municipal drain for collection of night soil of CDTSs

(iii) Automatic coaches wash plant as per COFMOW's specification number COFMOW/IR/M-CWP/2010.

(iv) Covered shed as per drawing with – (i) 25/10 tonne EOT cranes for sick line. Or
(ii) Automatic coach lifting plant and bogie turn tables

M&P required at Sick line.

S.No	Descriptions	Qty
1	Synchronized electrically operated whitening jack capacity15 tonne (Set of 5 nos.)	2
2	Inverter based AC/DC TIG welding machine	1
3	Synergic pulse Tag welding plants	8
4	Synergic Tag welding plant	2
5	Welding rectifier	1
6	Air plasma cutting machine	2
7	Pick & carry mobile crane 10 tonne	2
8	Hydraulic material carrying and lifting system – For lowering and carrying of CBC	2
9	Milling machine 36x8 Gear head	1
10	Walk behind power vacuum sweeper	1
11	Pendulum action jig saw machine	1
12	Single car test rig for air brake system (Fixed)	1
13	Single car test rig (mobile) RDSO sketch No. 81110	1
14	Test bench for distributor valve	1
15	Test bench for brake control panel	1
16	Test bench for CDTS	1

S.No	Descriptions	Qty
Tools & Equipments required at sick line		
1	Square drive torque wrench 1” male square drive for fastening of Nuts and bolts of Bogie frame.	1
2	Hydraulic torque wrench – For Nuts and bolts of Bogie frame	1
3	Torque wrench (ratchet) torque 38 Kg-m sq. drive ¾”	4
4	Torque wrench (ratchet) torque 3-14 Kg-m sq. drive ½”	4
5	Torque wrench (ratchet) torque 7-35 Kg-m sq. drive ½” and ¾”	4
6	Gauge for checking Bearing Mounted End Play.	1
7	Bench end-play checking fixture.	1
8	Fixture for bearing lubrication	1
9	Spring testing machine for Load/Deflection	1
10	Testing machine for Yaw dampers.	1
11	Vernier dial calliper 0-300 mm	1
12	Vernier calliper 0 – 600 mm	1
13	Vernier Calliper 0-2000 mm- For inspection of bogie frame	2
14	Vernier height gauge 18”	1
15	Vernier calliper (digital)	1
16	Micrometer digimatic range 125 to 150 mm	1
17	Micrometer digimatic range 150 to 200 mm	1
18	Digimatic inside micrometer tubular range 175 to 200 mm	1
19	Inside micrometer range 175-225 mm	2
20	Digimatic inside micrometer tubular range 200 to 225 mm	1
21	Dry film thickness measuring equipment	1
22	Gloss meter	1
23	Surface roughness comparator 30 specimens	1
24	Bench pillar drilling machine	1
25	Portable hand drill machine	2
26	Tool cabinet	As per requirement
27	Material handling crate	---do--
28	Cleaning sink	---do--
29	Impact spanner	---do--
30	Pallet trolley	---do--
31	Feeler gauge	---do--

S.No	Descriptions	Qty
32	Allen key set as per list	---do--
33	One meter stainless steel scale	---do--
34	12” stainless steel scale	---do--
35	Measuring taps 03 mtrs.	---do--
36	Steel rule	---do--
37	Heavy duty rechargeable torch	---do--
38	Helmet	---do--
Office Equipments		
1	Set of Computer of latest Configuration and operating system along with UPS	As per requirement
2	Scanner (A-4) size	---do--
3	Printers	---do--

M&P and tools required at Pit line.

1. Tool kit (Torque wrenches, Allen keys, pliers, spanners set etc.)
2. High pressure jet cleaning machine.
3. Axle dia measurement gauge/micrometer.
4. GO/NO GO threads plug gauge for axle ends.
5. Parallelism checking tool for control arm.
6. Equipment for pneumatic System Functional Test.
7. Single car testing rig for air brake system.
8. Mounting/ dismounting tools for Anti roll bar bearing.
9. Mounting/ dismounting tools for Anti roll bar elastic joint.
10. Miner pad pressing Fixture
11. Inspection torches
12. Spiked hammers
13. Ball peen hammers
14. Goggles for inspection staff
15. Measuring tape
16. Measuring scale
17. Gas cutting plants
18. Multi-operator welding plants
19. Electrical angle grinders
20. Pneumatic hand grinders

WORKSHOP

M&P required

S.no	Descriptions	Qty
1	Synchronized electrically operated whitening jack 15 tonne capacity (Set of 5 nos.)	2 Sets
2	EOT crane – 25/10 tonne	2
3	Bogie load testing machine.	1
4	Rail cum Road vehicle for shunting	1
5	Coil spring scragging and load deflection testing m/c Cap 20 T for primary spring	1
6	Horizontal tensile testing machine for testing of CBC	1
7	Shock absorber testing machine with pc display and print out faculties	1
8	Load deflection testing machine with lateral measurement for flexi coil springs	1
9	Dynamic balancing machine- for wheel set	1
10	Grit blasting booth	
11	Painting booth of one coach length with complete consisting of:- i) Airless spray painting unit ii) Full-fledge Effluent Treatment Plant iii) Dedicated Compressor iv) Winches for movement of coach	
12	Oven for forced curing of paint coating	
13	Fire fighting equipments	
14	Paint/putty mixing/grinding machine, material handling trolley and ladles.	
15	Inverter based AC/DC TIG welding machine	1
16	Synergic pulse Tag welding plants	8
17	Synergic Tag welding plant	2
18	Portable profile cutting machine	1
19	Welding rectifier	1
20	Milling machine	1
21	Pick & carry mobile crane 10 tonne	2
22	Static electronic Rail-road weighs bridge, for weighing of Coach	1
23	Hydraulic material carrying and lifting system – For lowering and carrying of CBC	2
24	Single car test rig for air brake system (fixed)	1
25	Single car test rig (mobile) RDSO sketch No. 81110	1
26	Test bench for distributor valve	1

S.no	Descriptions	Qty
27	Test bench for brake control panel	1
28	Simulator cum test bench CDTS	1
29	Press for removal of silent block	1
30	CTRB Extractor	2
31	Air plasma cutting machine	4
32	Pendulum action jig saw machine	1
33	Walk behind power vacuum sweeper	2
Tools & Equipments		
1	Surface table 4mx3m-grade-2, IS- 2285- For alignment testing of LHB	1
2	Square drive torque wrench 4200 M1" male square drive for fastening of Nuts and bolts of Bogie frame.	1
3	Hydraulic torque wrench – For Nuts and bolts of Bogie frame	1
4	Torque wrench (ratchet) torque 38 Kg-m sq. drive ¾"	4
5	Torque wrench (ratchet) torque 3-14 Kg-m sq. drive ½"	4
6	Torque wrench torque 7-35 Kg-m sq. drive ½" and ¾" bit	4
7	Vernier dial calliper 0-300 mm	1
8	Vernier calliper 0 – 600 mm	1
9	Vernier Calliper 0-2000 mm, for inspection of bogie frame	2
10	Vernier height gauge 18"	1
11	Vernier calliper (digital)	1
12	Micrometer digimatic range 125 to 150 mm	1
13	Micrometer digimatic range 150 to 200 mm	1
14	Digimatic inside micrometer tubular range 175 to 200 mm	1
15	Digimatic inside micrometer tubular range 200 to 225 mm	1
16	Dry film thickness tester	1
17	Ford cup 4 No.	2
18	Gloss meter	2
19	Inside micrometer range 175-225 mm	2
20	Bench pillar drilling machine	1
21	Surface roughness comparator 30 specimens	1
22	Phased array ultrasonic flaw detector	1
23	Ultrasonic air leakage detector	2
24	Portable hand drill machine	2
25	Digital stop watch with split time	6

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S.no	Descriptions	Qty
26	Tool cabinet	As per requirement
27	Material handling crate	---do--
28	Trestles for coach body	---do--
29	Cleaning sink	---do--
30	Impact spanner	---do--
31	Pallet trolley	---do--
32	Feeler gauge	---do--
33	Allen key set	---do--
34	One meter stainless steel scale	---do--
35	12” stainless steel scale	---do--
36	Measuring taps 03 mtrs.	---do--
37	Steel rule	---do--
38	Heavy duty rechargeable torch	---do--
39	Helmet	---do--

APPENDIX 'D"

TRANSPORTATION CODE FOR THE LHB COACH

Sr.No	TYPE OF COACH	CODE
1	AC FIRST CLASS SLEEPER- (EOG)	LWFAC
2	AC FIRST CLASS SLEEPER- (SG)	LWGFAC
3	AC SECOND CLASS SLEEPER- (EOG)	LWACCW
4	AC SECOND CLASS SLEEPER- (SG)	LWGACCW
5	AC THREE TIER CLASS SLEEPER- (EOG)	LWACCN
6	AC THREE TIER CLASS SLEEPER- LACCN (SG)	LWGACCN
7	AC DOUBLE DECKER AC CHAIR CAR (EOG)	ACCC DOUBLE DECKER
8	AC HOT BUFFET CAR	LWCBAC
9	LHB GS EOG coach fitted with the new inner spring design of secondary suspension (LW05127) with a combination of existing LG05101 outer spring (Shalimar coach secondary outer spring) and Rubber spring with 36 mm shim.	LS4
10	NON AC SECOND CLASS THREE TIER–(SG)	LWGSCN
11	NON AC- LUGGAGE CUM GUARD VAN(SG)	LGSLR
12	AC CHAIR CAR EXECUTIVE CLASS	LWFCZAC
13	AC CHAIR CAR	LWSCZ AC
14	GENERATOR CUM LUGGAGE& BRAKE VAN	LWLRRM
15	EOG NON AC HOT BUFFER LHB COACHES	LWCB
16	EOG AC FIRST CLASS CUM AC TWO TIRE LHB COACH	LWFCACCW
17	II class non-AC EOG LHB variant in BG coach fitted with modified suspension on FIAT bogie with suspension to Drawing No. LG 90018 with 32 mm shims without 2 under slung water tanks of 685 Lt capacity, luggage rack shifted upward by 440 mm.	LS 2`
18	II class non-AC EOG LHB variant in BG coach fitted with modified suspension on FIAT bogie with suspension to Drawing No. LG 90019 with 32 mm shims without 2 under slung water tanks of 685 Lt capacity, luggage rack shifted upward by 440 mm.	LS 3
19.	EOG non AC chair car LHB variant coaches fitted with FIAT bogie with 16.25 t axle load	LWSCZ

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OUR OBJECTIVE

To upgrade maintenance technologies and methodologies and achieve improvement in productivity, performance of all Railway assets and manpower which inter-alia would cover reliability, availability, utilisation and efficiency.

If you have any suggestions and any specific Comments please write to us.

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